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CONTRIBUTIONS TO THE STRATIGRAPHY OF THE ALLEGHENY SERIES IN COLUMBIANA AND MAHONING COUNTIES, OHIO

PART I. STRATIGRAPHY AND CORRELATION OF THE COALS AND LIMESTONE BELOW THE LOWER KITTANNING COAL

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The general stratigraphic section and many of the details of the geology of Columbiana and Mahoning Counties are known from the published reports of Newberry, Orton, Stout and Lamborn, and others. As time goes on, however, new data that add to the already existing store of geologic knowledge or that necessitate some minor revision of the present correlation of the various strata are discovered. Some years ago I began the study of the invertebrate fossils of the Allegheny Series in that portion of these two counties within the Lisbon Quadrangle, and as the study has progressed some new facts concerning the stratigraphy have been found. It is proposed to present this new information in three separate parts under the general title given above (see Fig. 1):

- Part I. Stratigraphy and Correlation of the Coals and Limestone below the Lower Kittanning Coal.
- Part II. Stratigraphy of the Middle Kittanning Coal between Greenford and Washingtonville, Ohio.
- Part III. Stratigraphy, Petrology, and Paleontology of the Salem Limestone.

LOCATION

There are two coals and one shaly marine limestone below the Lower Kittanning coal and above drainage in the northeastern quarter of the Lisbon Quadrangle. The limestone is closely associated with the lowermost coal, and these two members occur in Sections 4, 7, and 18, Green Township, Mahoning County. Other exposures of the same members are known further north in the adjacent Warren Quadrangle, and this same coal without the overlying shaly limestone may be present along Little Beaver Creek south of New Albany.

The Lower Kittanning coal is 25 to 35 feet higher than the above members, and a few inches to several feet below the base of the Lower Kittanning coal is the second coal which is normally thin and irregular in distribution. This second coal is present in localities under consideration at present from the northern edge of the Lisbon Quadrangle at least as far south as Section 15, Salem Township, and also at Coleman in Section 9, Center Township, Columbiana County. It is reasonably certain that the lowermost coal and the limestone are the Clarion and Vanport members, respectively, and the coal occurring just below the Lower Kittanning coal is without doubt the Lawrence coal.

The various known localities of these three members in this vicinity are shown in Figure 2, and the stratigraphic sections are plotted in Figure 4.

STRATIGRAPHY

Clarion Coal and Vanport Limestone.—Lamb, who was apparently the first to observe and mention the Vanport limestone in this area, described it in 1910 under the name of Howenstein limestone on the Ira Unger farm along a tributary to



Fig. 1. Map of Ohio showing location of Columbiana and Mahoning counties and the Lisbon and surrounding quadrangles.

Meander Creek in the northwest quarter, Section 4, Green Township, Mahoning County.¹ The strata along this small stream are of special interest; for there are two closely associated coal beds further upstream on the John Ewing (now

¹Lamb, G. F.: *Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal*, Ohio Naturalist, vol. 10, pp. 115-117. (1910.)



Fig. 2. Northeastern portion of the Libson Quadrangle showing locations of stratigraphic sections described in the text and shown in the correlation diagram (Fig. 4).

Ray Hagstrom) farm in the southwest corner of Canfield Township, Mahoning County. These two coals were formerly mined, although the lower coal was of very poor quality (See Figure 3A). Mining probably began before 1878, for in that year Newberry wrote as follows:²

"On the Erving farm, in the southwest corner of Canfield (township) it is two and a half feet thick, two feet bituminous, and six inches of the upper part cannel. Here another coal seam two feet thick, probably Coal No. 3a, lies about eight feet under it, but the interval is usually much greater."

Although Newberry wrote "Erving" instead of "Ewing," the location and description given are those of the locality under discussion.

Orton visited the locality when the mining of the upper coal was still in progress, and identified it as the Canfield Cannel or Scrub Grass or Upper Clarion coal in 1884.³ Orton's interpretation would identify the lower coal as the Clarion as recognized in the standard section for the Pennsylvanian System by the present Geological Survey of Ohio.⁴ The mines are long since abandoned (See Fig. 3B) and only the upper coal can be seen in very limited exposures near the old mine entrance and along the adjacent road. In August, 1938, I visited this valley and with the help of information from Mr. Elmer Ewing and Mr. Ira Unger determined the following section and interpretation of it:

15. Glacial till.....	19' 6"
14. "Draw slate".....	1' 6"
13. Coal: cannel.....	} <i>Lower Kittanning</i> { 0' 5"
12. Coal: bituminous..	
11. Clay: plastic.....	7' 0"
10. Shale.....	1' 0"
9. Coal: bituminous, poor quality, <i>Lawrence</i>	1' 10"
	to 3' 2"
8. Clay: plastic (?)	
7. Shale: gray, arenaceous, with few plant fossils.....	9' 0"
6. Shale and sandstone: upper 15-18 feet consists largely of gray, fine grained, thin bedded, and micaceous sandstone with some interbedded shale layers, lower part is gray, arenaceous, and micaceous shale with layers or lenses of fine grained sandstone up to several feet in thickness.....	30' 0"
5. Shale: gray, fossiliferous, with clay ironstone concretions.....	} <i>Vanport</i> { 3' 9"
4. Limestone: dark gray to black, somewhat flinty in appearance, but actually not siliceous, shaly appearance on weathering, fossiliferous.....	
3. Shale: dark gray, fossiliferous, with 1-inch ferruginous layer at top, exposed.....	
2. Covered interval.....	17' 6"
1. Coal: reported to be thin, <i>Clarion</i> .	

²Newberry, J. S.: *Report on the Geology of Mahoning County*, Geol. Surv. Ohio, vol. III, pp. 795-796. (1878.)

³Orton, Ed.: *The Stratigraphical Order of the Lower Coal Measures of Ohio*, Geol. Surv. Ohio, vol. V, pp. 31 and 34. (1884.)

⁴Bownocker, J. A., and Dean, E. S.: *Analyses of the Coals of Ohio*, Geol. Surv. Ohio, 4th series, Bull. 34, chart opposite p. 6. (1929.)



Fig. 3. A. The Ewing Mine from the south side at about the time of its abandonment in 1908 or 1909. The white line marks the approximate dip of the Lower Kittanning coal toward the east, and the arrow points to the entrance of the slope to the Lawrence coal. The two men are John (left) and Elmer Ewing. Original photo by Herbert Knauf; reproduced here through the courtesy of Elmer Ewing.



Fig. 3. B. The above location today (May, 1943) from the southeast. The young man is standing on the same mound that the Ewings are in the above picture.

The Clarion coal is not exposed and is reported by Mr. Unger from a test drill hole. Orton reported fragments of a blue fossiliferous limestone above the cannel coal, and if these fragments were in place, they undoubtedly represent the Hamden limestone.

Mr. Nick Weingart formerly operated a small mine on the Clarion coal on the north side of the Little Beaver Creek in the east-central part of Section 7, Green Township, Mahoning County. I measured the following section in December, 1932:

7. Shale: dark gray, argillaceous, sparingly fossiliferous, exposed.....	} Vanport.....	1' 8"
6. Shale: similar to zone 5 but thinner bedded, very fossiliferous.....		0' 10"
5. Shale: dark gray to black, very fossiliferous; with an almost continuous layer of pyritiferous and fossiliferous limestone nodules.....		0' 4"
4. Coal: with numerous thin discontinuous marcasite partings and with calcite in joints near the top, <i>Clarion</i>		1' 6"
3. Clay: light gray with buff stain, plastic, arenaceous toward base.....		5' 10"
2. Shale: light gray with buff stain, arenaceous, grades into plastic clay above, exposed.....		2' 0"
1. Level of Little Beaver Creek.		

This locality was excellent for collecting invertebrate fossils, especially gastropods, cephalopods, and brachiopods.

On the farm of Harry Gordon across Little Beaver Creek from the abandoned Weingart mine I measured the following section in an abandoned mine entrance and a nearby wash in September, 1938:

10. Shale: gray to buff, arenaceous; with numerous clay ironstone concretions, exposed.....		16' 0"
9. Shale: gray, fossiliferous.....	} Vanport.....	2' 6"
8. Shale: dark gray to black, flinty in appearance, sparingly fossiliferous.....		1' 0"
7. Shale: dark gray, sparingly fossiliferous.....		5' 0"
6. Shale: gray, similar to but lighter gray than shale of zone 5, fossiliferous at least in basal part.....		7' 6"
5. Shale: dark gray, argillaceous, fossiliferous.....		3' 0"
4. Limestone: dark gray, shaly, fossiliferous.....		0' 6"
3. Shale: dark gray, fossiliferous.....		1' 9"
2. Coal: <i>Clarion</i>		1' 6"
1. Clay: plastic, unmeasured.		

A similar section but one that is less well known in detail occurs on the A. V. Kenreigh farm almost on the boundary between the northwest quarter and northeast quarter of Sections 17 and 18, respectively, Green Township, Mahoning County. There the exposure is along the channel of a small intermittent stream and in two shallow shafts that were dug several years ago to prospect the Clarion coal. The shafts were partly filled by water when visited in 1939, and the following section was determined partly by studying the refuse piles and the exposures along the stream and partly by information given by Mr. Kenreigh:

5. Shale: weathered, unmeasured.

4. Limestone: dark gray to black, fossiliferous, similar in lithology to limestone on the Unger farm.....

3. Shale: blue gray, fossiliferous; with small scattered clay ironstone concretions; thickness approximate...

2. Limestone: dark gray, nodular, fossiliferous.....

1. Coal, *Clarion*.....

Vanport.....

1' 4"

8' 0"

0' 4"

1' 0"

It is assumed that the nodular limestone lies directly on the coal, as some of the nodules which are in the refuse piles have bits of coal adhering to them in the

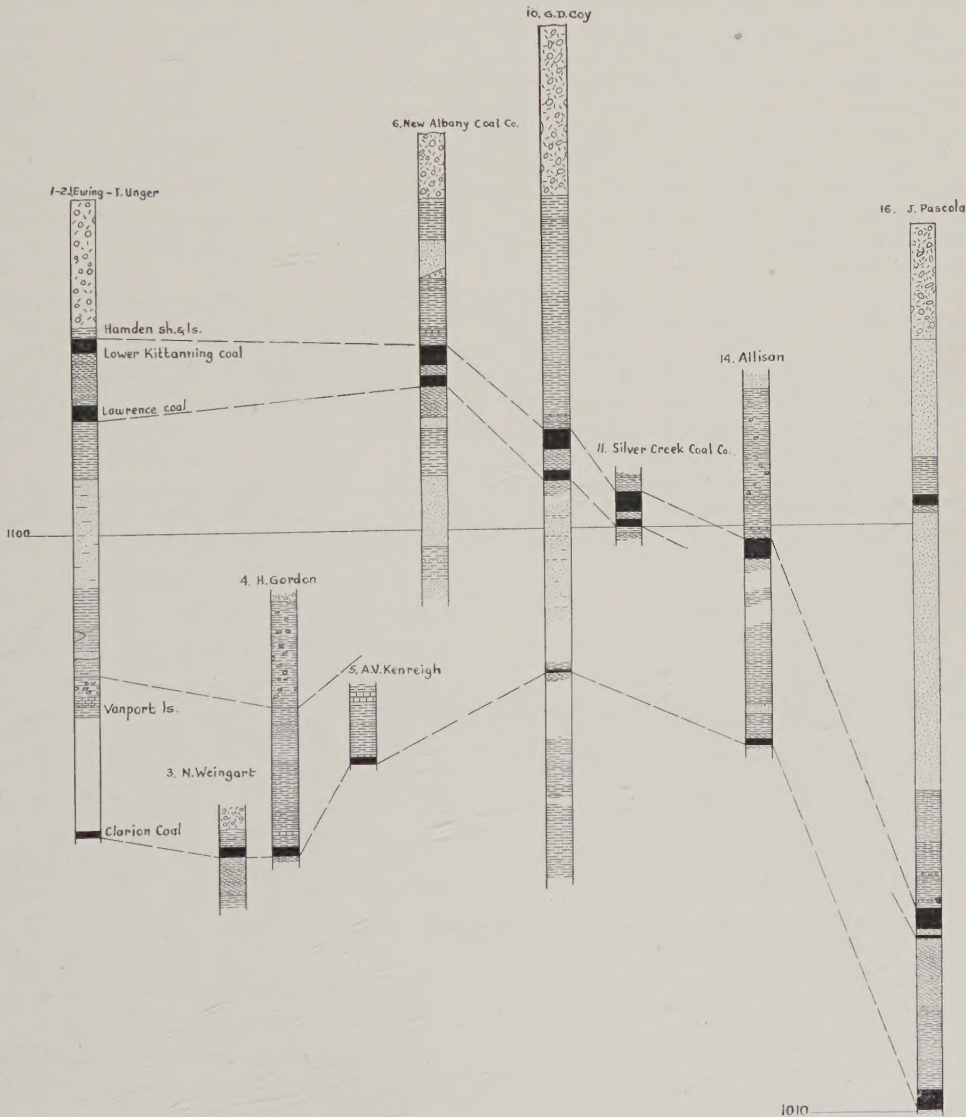


Fig. 4. Correlation diagram of the strata below the Lower Kittanning coal in the northeastern part of the Lisbon Quadrangle.

same manner as those at abandoned Weingart mine. It is reported by Mr. Kenreigh that the limestone, No. 4, in the above section was burned by his grandfather for lime almost a century ago and that mounds still mark the sites of those burnings.

It is evident from these four sections that the Vanport member is represented by a considerable thickness of fossiliferous shale with variable interbedded nodular or shaly limestone overlying the Clarion coal. This thickness reaches a known maximum at the abandoned mine on the Harry Gordon farm with a total of 21 feet. On the Kenreigh farm the known thickness is about 10 feet, and it is probable that the weathered shale on top of the limestone is also fossiliferous. The entire thickness of shale and limestone at the abandoned Weingart mine contains fossils but only 2 feet and 10 inches are exposed. There are 6 feet and 9 inches of fossiliferous strata exposed on the Unger farm, but if the 17 feet and 6 inches of strata overlying the coal below drainage are fossiliferous, the thickness of fossiliferous strata would be in excess of 24 feet. These sections are similar in lithology and of even greater thickness than those of the Vanport member described by Stout and Lamborn in Elk Run and St. Clair Townships, Columbiana County.⁵

As far as known there are no exposures of the Vanport member along Little Beaver Creek south of the exposure on the Kenreigh farm, but it may be covered by mantle rock along the lower slopes of the valley sides. In addition to the sections with the Vanport member there are four locations of coal, probably Clarion, known in this vicinity.

A short distance north of New Albany between the old and new locations of Route 62 at the buildings of the D. McConnell farm a shallow shaft to a coal below the Lower Kittanning coal was in operation during the First World War. This shaft has been abandoned and filled, and to date I have been unable to get any detailed information concerning it. It is reasonably certain that the Clarion coal was the coal mined in this shaft. Evidence concerning the presence of the Vanport member is wanting.

The other three are exposures, the first of which is located in a ravine near the New Albany-Greenford road in the southeast quarter of Section 16, Green Township, Mahoning County. The section here and in the nearby abandoned G. D. Coy shaft mine is as follows:

18. Glacial till: cribbed.....	25'	0"
17. Shale: gray, weathered.....	4'	0"
16. Shale: gray.....	30'	0"
15. Shale: gray, fossiliferous; with nodules of fossiliferous limestone, thickness variable.....	} Hamden..... {	1' 0"
14. Shale: black, bony, fossiliferous.....		1' 3"
13. Coal, <i>Lower Kittanning</i>		3' 0"
12. Clay: gray, plastic.....		3' 4"
11. Coal, <i>Lawrence</i>		1' 6"
10. Clay: plastic, unmeasured.		
9. Sandstone: gray or stained buff, fine, friable, micaceous, bedded; with shaly layers and lenses.....	20±'	
8. Covered interval.....	6'	0"
7. Shale: gray, weathered, exposed.....	1'	0"
6. Coal, <i>Clarion</i>	0'	4"
5. Clay: gray, arenaceous, plastic, exposed.....	1'	0"

⁵Stout, W., and Lamborn, R. E.: *Geology of Columbiana County*, Geol. Surv. Ohio, 4th series, Bull. 28, pp. 68-70. (1924.)

4. Covered interval.....	9' 3"
3. Shale: gray; with clay ironstone concretions, exposed.....	9' 1"
2. Covered interval.....	1' 2"
1. Shale: gray, arenaceous, exposed.....	11' 0"

The interval between the base of the Lower Kittanning coal and the top of the Clarion coal is a little more than 30 feet. No evidence of the Vanport member can be seen, but the exposure is poor. At places in the Coy mine there is a thin layer of cannel coal at the top of the Lower Kittanning coal. This is most common toward the eastern edge of the lease and in the swamps where the coal is thickest. The Hamden member is everywhere marine.

The Clarion coal is exposed at a little abandoned mine on the Allison farm in the northwest quarter, Section 29, Perry Township, Columbiana County. The section exposed here in September, 1938, is as follows:

14. Sandstone: gray, thin bedded, micaceous, exposed.....	2' 0"
13. Shale: gray, arenaceous and ferruginous; with numerous clay ironstone concretions.....	17' 0"
12. Shale: light gray, argillaceous, soft.....	0' 9"
11. Shale: dark gray, fossiliferous.....	Hamden..... { 3' 6"
10. Shale: dark gray, very fossiliferous; with fossiliferous limestone nodules.....	
9. Shale: black, bony, fossiliferous.....	
8. Coal, <i>Lower Kittanning</i>	3' 0"
7. Clay: plastic.....	} partly covered 22' 4"
6. Shale: ?.....	
5. Sandstone: gray weathering buff, a single ledge showing bedding on weathering.....	1' 5"
4. Shale: gray and buff, arenaceous, thickness variable.....	3' 0"
3. Clay-shale: light and dark, soft.....	0' 8"
2. Coal, <i>Clarion</i>	0' 10"
1. Clay: plastic; unmeasured.	

There are 27 feet and 5 inches between the base of the Lower Kittanning coal and the top of the Clarion coal in this section. It is possible that there may be fossils in the partly covered shale, zone 6 of the section, but none were seen.

John Pascola formerly operated a shaft mine under the name of the New Salem Coal Company on the south side of the Salem-Washingtonville road (Route 14) in the southern part of Section 33, Green Township, Mahoning County. Four coals are shown in this shaft and a slope which extends 24 feet deeper than the base of the shaft. The entire section measured in March, 1933, in this mine is given below:

18. Cribbing.....	17' 6"
17. Sandstone: massive, <i>Lower Freeport</i>	18' 0"
16. Shale: dark gray.....	6' 0"
15. Coal, <i>Middle Kittanning</i>	1' 6"
14. Clay: plastic.....	1' 0"
13. Sandstone.....	43' 0"
12. Shale: gray, argillaceous.....	12' 6"

11. Shale: gray, argillaceous, fossiliferous; with many clay ironstone concretions.....	Hamden.....	{	0' 6"
10. Shale: gray, argillaceous, fossiliferous; with few clay ironstone concretions.....			3' 6"
9. Shale: dark gray, calcareous, very fossiliferous; with fossiliferous limestone nodules.....			1' 0"
8. Shale: black, bony, fossiliferous.....			0' 6"
7. Coal: contains thin partings of marcasite, one of which near the top is about 1 inch thick and fairly persistent, <i>Lower Kittanning</i>			3' 2"
6. Clay: gray or gray-drab, plastic.....			1' 0"
5. Coal: locally present, <i>Lawrence</i>			0' 5"
4. Clay: gray, plastic.....			11' 0"
3. Shale: gray, arenaceous; with some clusters of clay ironstone concretions.			12' 0"
2. Coal: interbedded with thin lensing layers of shale containing plant fossils.....	Clarion.....	{	0' 3"
1. Coal: contains numerous thin shaly partings. One of these partings is an inch or so in thickness near the base of the thicker portions of the coal.....			2' 8"

It is certain that there are no marine fossils in the shale overlying the Clarion coal in this section. An attempt was made to mine the Clarion coal here, but while it was of sufficient thickness, the quality was such that the attempt was soon abandoned. It is reported that a bed of coal was exposed in the channel of Little Beaver Creek about one-half mile northeast of the Pascola shaft when the highway bridge was built at that point a few years ago. If this is true, the coal is also the Clarion member.

At Long's Crossing located five miles south of the Pascola shaft in the southeast quarter, Section 28, Salem Township, Columbiana County, the Clarion member is absent but the underclay is apparently present as shown in a test hole drilled from near the base of the Upper Freeport coal to a depth of 253 feet. A record of this test hole is available through the courtesy of Mr. Homer Callahan, and the portion of the record from the Lower Kittanning coal to the Clarion clay is given:

10. Coal, <i>Lower Kittanning</i>	2' 8"
9. Clay.....	4' 4"
8. Shale: gray.....	3' 6"
7. Clay.....	2' 6"
6. Shale: gray.....	7' 0"
5. Shale: brown.....	3' 0"
4. Shale: gray.....	4' 0"
3. Sandstone: gray; with streaks of shale.....	12' 0"
2. Clay, <i>Clarion</i> (?).....	2' 0"
1. Sandstone and shale: gray.....	30' 0"

The interval between the Lower Kittanning coal and the Clarion clay is about 36 feet.

The Allison and Pascola sections show that the Clarion coal is present along Little Beaver Creek as far south as the Columbiana-Mahoning county line east of the City of Salem. Thus the Clarion coal is present for a distance of six miles from the northern to southern boundaries of Green Township, Mahoning County, along the headwaters of Meander Creek and Little Beaver Creek, and in the northern two miles of this extent the associated Vanport member is also present. In this area the Clarion coal has been prospected and mined to a very limited extent, but it had practically no economic value in the past and promises to have little in the future because of its irregular and thin development and because

of its poor quality. The Vanport member has been used to a very limited extent for agricultural lime in times past, but its shaly and impure character give little or no promise for future uses. Both the Clarion and Vanport members are useful to the stratigrapher in determining the complete stratigraphic section of this area.

The Lawrence Coal and Clay.—In 1938 when test drillings were made preparatory to opening the New Albany Coal Company's strip mine on the Lower Kittanning coal in Sections 17 and 18 of Green Township, Mahoning County, the promoters were surprised to discover a second coal lying almost directly beneath the Lower Kittanning coal in that area. The local miners had various names and numbers for this lower coal, but it is without question the Lawrence coal, the normal position of which is several feet below the Lower Kittanning coal.⁶ This Lawrence coal is present as a thin, impure, and irregular bed with a discontinuous distribution in the northeastern portion of the Lisbon quadrangle. It may be more commonly present than is usually suspected. I have made no systematic effort to locate all known localities of occurrence within the area, but a number have come to my attention.

The Lawrence coal is present in the previously described sections on the Ewing and Unger farms and in the Coy and Pascola shafts. Orton mentions three sections in which the Lawrence coal is present in addition to the Ewing locality.⁷ It is well exposed in the New Albany Coal Company's strip mine mentioned above, where J. O. Fuller and I determined the following composite section along the face of the mine and in a drainage ditch in 1941:

19. Glacial till.....			10' 0"
18. Shale: brown, arenaceous, exposed.....			6' 0"
17. Sandstone: light gray, medium to coarse, micaceous, bedded.....			4' 6"
16. Sandstone: lens of bluish gray, quartzitic-appearing sandstone, with disconformable and conglomeratic base that has pebbles of local origin; grades laterally and upward into above sandstone, thickness variable..			1' 6"
15. Shale: dark gray, pyritiferous.....			2' 0"
14. Shale: dark gray, fossiliferous; with few clay iron-stone concretions.....	} <i>Hamden</i>	{	6' 0"
13. Shale: dark gray, fossiliferous; with nodular fossiliferous limestone at top.....			0' 10"
12. Shale: black, bony, fossiliferous.....			1' 6"
11. Coal: with partings of marcasite and fusain.....	} <i>Lower Kittanning</i>	{	2' 8"
10. Coal: impure, with much marcasite and fusain....			0' 3"
9. Clay: gray to dark gray, plastic.....			1' 6"
8. Coal: impure; with much marcasite and fusain.....			1' 4"
7. Shale: dark gray, carbonaceous, with streaks of marcasite and coal, weathers yielding sulphur....	} <i>Lawrence</i>	{	0' 4"
6. Clay: light gray, plastic, arenaceous, especially in lower part.....			4' 6"
5. Sandstone: white weathering buff, fine, micaceous, thin-bedded.....			2' 0"
4. Shale: dark gray, micaceous, arenaceous; with thin layers of sandstone and apparently grading laterally into sandstone.....			7' 0"
3. Sandstone: light gray, platy, micaceous, carbonaceous, irregularly bedded.....			11' 0"
2. Shale and sandstone: gray to dark bluish gray, micaceous, arenaceous and carbonaceous shale with irregular layers and lenses of shaly, micaceous, and carbonaceous sandstone, thickness variable.....			5' 0"
1. Sandstone: gray weathering yellowish, medium, micaceous, massive, exposed.....			3' 0"

⁶Bownocker, J. A., and Dean, E. S.: *Op. Cit.*, chart opp. p. 6 and p. 53.

⁷Orton, Ed.: *Op. cit.*, pp. 32, 33, 180, and 194.

The strata in this strip mine are irregular. There is an apparent dip of seven degrees in the beds exposed along the drainage ditch. The Lower Kittanning coal rises and falls as much as 30 feet in distances of 200 feet in the mine. The coal has thickness up to 42 inches in the swamps but only averages about 18 inches and may even run out on the swells. The Hamden member is considerably thicker and much more massive appearing in the swamps.

The Lower Kittanning and Lawrence coals can be seen in similar relationship along Route 62 in the road cut in New Albany. The localities of Lower Kittanning and Lawrence coals cited by Orton are in the now abandoned Pettit mine at Cook's Crossing one mile north of Greenford in Section 11, Green Township, and at the now abandoned Walters mine in Section 35, Green Township, Mahoning County.⁸ At both places he believed that the upper coal was the Canfield cannel coal which he correlated as the Upper Clarion or Scrub Grass member and that the lower coal was the Clarion member. He was correct in correlating the upper coal with the Canfield cannel coal which is now known to be the Lower Kittanning coal, and the lower coal is now named the Lawrence coal. The limestone overlying the upper coal which Orton believed to be the Ferriferous or Vanport, is, of course, the Hamden member. Orton was undoubtedly led astray in his very logical interpretation by several facts, viz.: (1) the strongly undulatory character of the Lower Kittanning coal in the New Albany, Greenford, and Cook's Crossing areas where it rises and falls 30 feet at least in a horizontal distance of a couple of hundred feet, (2) the local absence of the Lawrence coal, (3) and the lack of knowledge at that time that fossiliferous marine limestone and shale of the Hamden member overlie the Lower Kittanning coal in this area. He believed that he recognized the Lower Kittanning coal in the old Reichstadt mine near Greenford in Section 23, Green Township, Mahoning County, where the thickness of 2½ feet of bituminous coal is overlaid by 4 to 6 inches of cannel coal. My latest studies have showed that the Reichstadt coal is probably the Middle Kittanning coal.⁹ This feature of a small thickness of cannel coal overlying a considerable thickness of bituminous coal is also true for Lower Kittanning coal at several localities northward from Greenford. Orton reported this to be the condition in the Pettit mine at Cook's Crossing in Section 11, Green Township and at the Ewing mine in the southwest corner of Canfield Township, Mahoning County.¹⁰ A similar relationship is present at places in the now abandoned G. D. Coy shaft in the southeastern corner of Section 16, Green Township, as shown in one of the previous sections and as reported by Lamborn.¹¹ In the southeastern quarter of Section 9, Green Township, the same relationship can be seen in the following section of the Lower Kittanning coal exposed in 1932 at the entrance of an abandoned mine:

6. Shale: dark, weathered, exposed.....	2' 0"	
5. Shale: gray to black, bony.....	0' 6"	
4. Shale: gray to black, fossiliferous.....	} <i>Hamden</i> {	1' 6"
3. Shale: black, bony, fossiliferous (?).....		0' 7"
2. Coal: cannel.....	} <i>Lower Kittanning</i> {	0' 4"
1. Coal: bituminous.....		3' 8"

It should be noted that the nodular limestone of the Hamden member is absent

⁸*Idem.*, pp. 32-33 and 180-181.

⁹Sturgeon, M. T.: *The Stratigraphy of the Middle Kittanning Coal between Greenford and Washingtonville, Ohio* (in preparation).

¹⁰Orton, Ed.: *Op. cit.*, pp. 31 and 32.

¹¹Lamborn, R. E.: *The Coal Beds in Southeastern Mahoning County*, Geol. Surv. Ohio, 4th series, Bull. 43, p. 30. (1942.)

in this section, but such absence occurs at other localities in this general area. The coal is somewhat thicker than average.

These several sections indicate that northward from Greenford the Lower Kittanning coal grades into the Canfield cannal coal.

The Lawrence coal is also represented in the section exposed at the entrance of the abandoned Silver Creek mine and in the nearby creek in the northwest quarter, Section 21, Green Township, Mahoning County:

8. Shale: dark gray, fossiliferous with large nodules of fossiliferous limestone, weathered.....	} Hamden.....	{	1' 3"
7. Shale: black, bony, fossiliferous.....			1' 1"
6. Coal: with many large flattened concretions of marcasite, <i>Lower Kittanning</i>			3' 0"
5. Clay: gray to dark gray or black, carbonaceous and shaly.....			1' 2"
4. Coal: good.....	} Lawrence.....	{	1' 2"
3. Coal: impure, bony; with numerous plant fossils.....			0' 2"
2. Shale: dark gray, carbonaceous, with very thin lenses of coal.....			0' 10"
1. Clay: light gray, plastic, arenaceous, exposed.....			1' 0"

The above section is not only similar to the section in the New Albany Coal Company's mine but also to those cited below by Orton.

There are probably numerous other localities at which the Lawrence coal is present, but most of them are not known first hand to me. At a small mine opening to the Lower Kittanning coal in the west-central part, Section 28, Green Township, Mahoning County, there are a few inches of Lawrence coal in the clay underlying the Lower Kittanning coal. In a shaft mine located in the northeast quarter of Section 15, Salem Township, the clay underlying the Lower Kittanning coal is reported by Mr. Francis Snyder to have a thin parting of coal. About five miles further south at Robbinsville (now Coleman), Orton found in the Rock Hill mine 20 inches of poor coal four feet below the Lower Kittanning coal.¹² Stout and Lamborn quote this section from Orton in their report on the geology of Columbiana County as the section in the old shaft along Middle Fork of Little Beaver Creek about one-half mile above Teegarden, but I am sure that it is the section in the old Maurer mine near Coleman.¹³ There are three reasons for this belief: (1) Orton wrote that the mine is entered by a slope, the coal lying at and below the level of low water in the creek. Above Teegarden it is the Middle Kittanning coal that is at creek level, and the mine there to the Lower Kittanning coal was a shaft. (2) Robbinsville is the old name for Coleman. (3) Orton mentioned a destructive gas explosion in this mine, and Mr. David Reese, of Logtown, recently described to me a destructive gas explosion of many years ago in the Maurer mine in which 12 miners were killed.

Stout and Lamborn did not discuss the Lawrence coal separately in their report on the geology of Columbiana County, but they did give sections in their discussion of the Lower Kittanning clay in which the Lawrence coal and its associated clay are present and recognized. The localities given by them are in St. Clair and Yellow Creek Townships and just over the boundary line in Pennsylvania.¹⁴ They also quoted Orton's previously cited section showing Lower Kittanning and Lawrence coals in the Rock Hill mine near Coleman and printed a picture showing the same coals along Yellow Creek near New Salisbury in Section 33, Yellow Creek Township.¹⁵

¹²Orton, Ed.: *Op. cit.*, pp. 194-195.

¹³Stout, W., and Lamborn, R. E.: *Op. cit.*, pp. 104-105.

¹⁴*Idem.*, pp. 78, 79, and 84.

¹⁵*Idem.*, p. 105 and Plate III, opp. p. 184.

From all the known evidences the Lawrence coal has a wide but a somewhat discontinuous distribution in the northeastern quarter of the Lisbon quadrangle. It is generally thin and of very poor quality, being shaly and at some places pyritiferous as well. It has been prospected locally but to my knowledge has never been mined to any large extent. Its principal value is to the stratigrapher for correlation purposes.

	Number of Localities	Member	Description	Thickness
12		<i>Hamden</i>	Shale: gray, marine, argillaceous, fossiliferous	4' 0"
11			Shale: gray to gray-black, marine, calcareous, fossiliferous; with nodular fossiliferous limestone, locally with cone-in-cone	0' 10"
10			Shale: black, marine or brackish, bony, fossiliferous	0' 8"
9	30	<i>Lower Kittanning</i>	Coal: with some marcasite and fusain	3' 0"
8	8*		Clay: gray to dark gray, plastic	2' 6"
7	8*	<i>Lawrence</i>	Coal: impure, locally absent	1' 8"
6	2		Clay: gray, plastic, arenaceous	7' 9"
5	4		Shale and sandstone, variable	25±'
4	4	<i>Vanport</i>	Shale: gray to dark gray, marine, variable, fossiliferous; with nodules and layers of shaly fossiliferous limestone	10±'
3	6	<i>Clarion</i>	Coal: at most places of poor quality, locally absent	1' 4"
2	1		Clay: gray or buff stained, plastic, arenaceous	5' 10"
1	3		Shale and sandstone	

*Used measurements from three localities given by Ed. Orton, Geol. Surv. Ohio, vol. V, pp. 33, 180, and 195. (1884.)

Fig. 5. Generalized section of exposed strata in the northeastern quarter of the Lisbon quadrangle below the Hamden shale and limestone.

SUMMARY

A composite and complete stratigraphic section of the rocks exposed below the Hamden member is given in Figure 5. The Lower Kittanning coal and overlying Hamden limestone are steady in their association and occurrence and uniform in their lithology. Hence these members are usually quite reliable but unfortunately not infallible guides in determining the stratigraphy. The last statement must be qualified because the Vanport member at two different places (see Weingart and Kenreigh sections) has nodular fossiliferous limestone in fossiliferous shale above the Clarion coal. Such a section of the Vanport and Clarion members could very easily be mistaken for the Hamden and Lower Kittanning members. The following criteria will, I believe, when fully and carefully applied, distinguish the two groups

from each other: (1) The Clarion coal averages only one-half or less of the thickness of the Lower Kittanning coal. (2) The black, bony shale or "draw slate" is poorly developed or absent above the Clarion coal. (3) The assemblage of fossils is somewhat different in the two marine members. Briefly the main faunal differences appear to be:

HAMDEN MEMBER:

1. Brachiopoda:
 - a. *Mesolobus mesolobus* var. *euampygus*—very abundant.
 - b. Large productids: *Dictyoclostus*, *Lino-productus*, *Juresania*—rare.
 - c. *Marginifera murcatina*—very abundant.
 - d. *Neospirifer cameratus*—very rare.
2. Pelecypoda: Various common genera abundant.
3. Gastropoda: Various common genera abundant.
4. Cephalopoda: Various common nautiloid genera fairly abundant; ammonoid genera rare.
5. Crinoidea: Stems absent.¹⁶

VANPORT MEMBER:

1. Brachiopoda:
 - a. *Mesolobus mesolobus* var. *euampygus* (?)—rare.
 - b. Large productids: *Dictyoclostus*, *Lino-productus*, *Juresania*—abundant.
 - c. *Marginifera murcatina* (?)—very abundant.
 - d. *Neospirifer cameratus*—abundant.
2. Pelecypoda: Various common genera abundant.
3. Gastropoda: Various common genera very abundant.
4. Cephalopoda: Various common nautiloid genera fairly abundant; ammonoid genera rare.
5. Crinoidea: Stems rare to moderately abundant.

The close association of the Lawrence coal with the Lower Kittanning coal can be used at some places as an aid in identifying the strata in question.

The economic value of all members described with the exception of the Lower Kittanning coal and clay and the Lawrence clay is negligible.

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¹⁶Recently (May, 1943), after eleven years of intermittent collecting from the Hamden member, I collected two crinoid segments from that member at the Pascola shaft in Section 33, Green Township, Mahoning County.

Useful Plants

About two years ago Mr. van Dersal produced a book on shrubs. Highly acclaimed both for its style and its illustrations, it gave to gardeners more than a local view. It attempted to cover the country and within its scope did an amazingly good job. This reviewer is similarly impressed with this new book. In presenting his own version of economic botany to classes, something of the same sequences of topics has been used for many years by the reviewer of this book, namely, the background of the original patterns of vegetational distribution as the setting for agricultural practices. Superb photographs are lavishly employed. The general reader cannot afford to miss this book.—A. E. Waller.

The American Land, by William R. van Dersal. 215+xvi pp.; 64 plates. Oxford University Press, New York. \$3.75.

A NEW GENUS (ASCIUS) AND TWO NEW SPECIES OF LEAFHOPPERS CLOSELY RELATED TO FLEXAMIA

(HOMOPTERA, CICADELLIDAE)

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The Ohio State University

Recent collecting in Mexico has brought to light large numbers of two rather common species of grass feeding leafhoppers closely related to species of *Flexamia*. Neither of these is apparently described and they do not seem to belong to *Flexamia*. A new genus is therefore being erected to include them at this time.

Genus *Ascius* n. g.

Closely related to *Flexamia* and with a similar superficial appearance. The most striking difference is the presence of a distinct keel or carina extending from the margin of vertex half the length of the face. The vertex margin is thin and foliaceous either side of apex formed by the deep concavity between the keel and the vertex margin. In lateral view the apex of the vertex appears thick margined due to the carina. The vertex is long and distinctly concave between the raised sharp edged margins. Venation of elytra similar to *Flexamia* with the reflexed costal veinlets. Type of genitalia similar to *Flexamia*.

Genotype *Ascius triangularis* n. sp.

All type material is in the author's collection.

Ascius triangularis n. sp.

In general appearance resembling a sharp headed species of *Flexamia*. Length 5 mm.

Vertex strongly produced, twice as long at middle as basal width between the eyes, more than one-third longer than pronotum. Disc of vertex concave, margins thin, foliaceous on either side. Face with a broad sharp carina extending from apex of vertex to middle of face. Elytra with one cross nervure between the claval veins and with costal reflexed veins.

Color: White with yellowish and brownish stripes. Anterior half of vertex white with faint markings either side of apex. Posterior half striped longitudinally. There is a proximal pair of broad white stripes and a narrower white stripe either side. There are five broad, longitudinal white stripes on pronotum, each bordered with brown. The scutellum has two broad white longitudinal stripes separated by the median third which is darker. The elytra are pale and irregularly marked with dark brown pigment. The white areas are so arranged that the elytra appear striped obliquely. The area along the claval vein is rather broadly white and an area between the costa and discal cell is almost entirely white. Face dark brown with a white spot just beneath apex, mottled with brown and a white longitudinal stripe on face at ventral end of keel.

Genitalia: Female last ventral segment with posterior margins broadly roundedly produced to a central broad sunken tooth which is slightly notched at middle. An underlying membrane either side is produced beyond the last ventral segment. Male valve produced, triangular, a little wider at base than median length. Plates exceeding valve by about one-half their length, broad, with blunt rounded apices. Style rather short, widened at middle, apical portion narrowed to form a short blunt finger-like process which curves outwardly. Aedeagus with a single basal portion, divided at half its length, forming a pair of long divergent processes which are heavy at base, widely separated by a U-shaped notch and tapered to slender pointed apices. A dorsal process similar in shape but much more slender extends from near base to the anal tube.

Holotype male, allotype female and male paratypes collected at Iguala, Gro., Mexico, September 11, 1939, by C. C. Plummer and the author and October 25, 1941, by E. E. Good and the author. They occur upon herbaceous vegetation.

***Ascius latus* n. sp.**

In form and general appearance resembling *triangularis* but with vertex broad and short and face with a slightly raised keel. Length 5–5.5 mm.

Vertex broad, one-fourth longer on middle than basal width between eyes, slightly longer than pronotum. Disc of vertex shallowly broadly concave, keel of face scarcely produced and visible only at apex.

Color: Similar to *triangularis*, white with yellowish and brownish stripes. Vertex with apical third white, basal portion brown with a faint median white line and a pair of longitudinal proximal pale stripes either side near middle. Pronotum with seven pale longitudinal stripes each bordered with dark brown. Scutellum with a pale longitudinal stripe either side of median third which is brown, basal angles darker brown. Elytra white, veins brown. Claval area, disc, claval area at anterior portion of anteapical cells and apical margin marked with dark brown. Face brown with pale irrorations, white just beneath margin at apex.

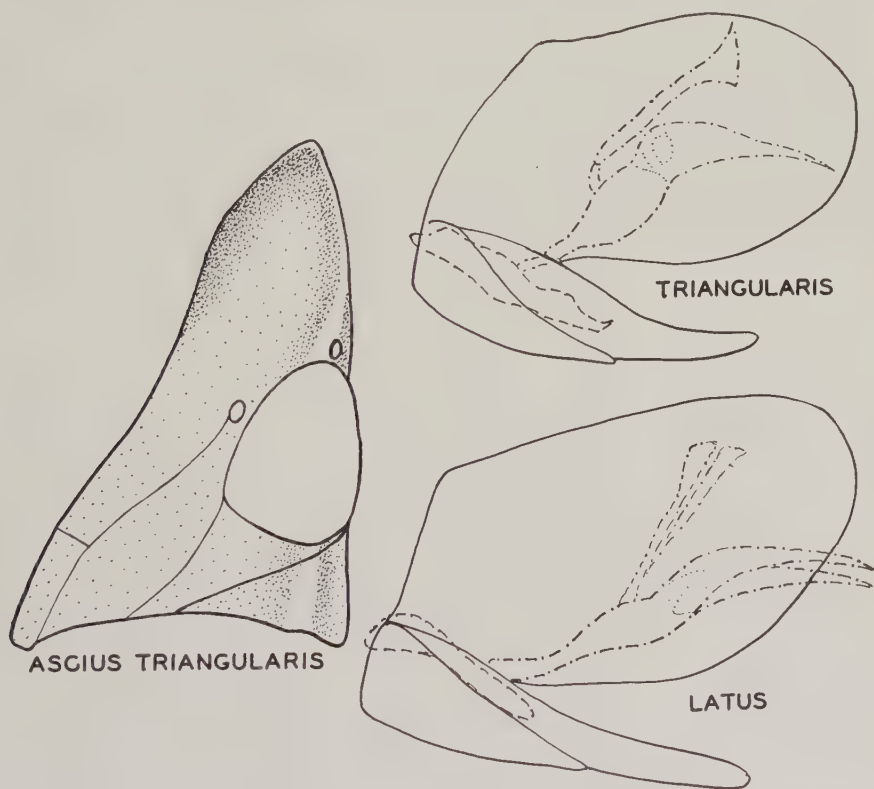


FIG. 1. Lateral view of head of *Ascius triangularis* (left); lateral view of genitalia of males of each species as labeled (right).

Genitalia: Male valve triangular, broader at base than median length. Plates triangular, broad at base, sloping to narrow, blunt, rounded apices. Style rather long and narrow with a rounded notch on outer margin just before apex forming an outwardly curved pointed finger-like process on inner margin. Aedeagus in general appearance similar to that of *triangularis* but shorter and broader. The single basal portion divides to form a pair of divergent processes which are heavy at base and taper to slender apices.

Although the genitalia of this and the former species are quite similar in structure, they are different, and externally the two species are quite different in structure.

Holotype male and paratype males collected at Iguala, Gro., Mexico, September 11, 1938, by C. C. Plummer and the author and October 25, 1941, by E. E. Good and the author.

A PORTABLE CASE FOR WATER ANALYSIS IN ECOLOGICAL FIELD WORK

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In ecological field work including the measurement of various physical conditions of the environment, the convenient transportation of equipment is always an important consideration, particularly when the analysis of natural waters is involved. The portable case described here was designed to carry the glassware and solutions used in the Winkler method for dissolved oxygen, a modified Seyler method for carbonates and free carbon dioxide and the colorimetric method for determination of pH. It was planned also to make possible analysis of water samples in the field permitting immediate calculation of results. The design is based upon the experience of carrying on such work with classes in elementary ecology and with graduate students engaged in the study of pond, stream and marine littoral communities. (Dreyer, 1940; Dreyer and Castle, 1941; King, Jos. E., 1943; King, Willis, 1934, and Ward, 1940.) Acknowledgment is made herewith of the accumulated suggestions of numerous students and co-workers. While not claiming complete originality of design the author presents this description to promote the more widespread use of such field equipment in ecological work of both the classroom and research level.

CONSTRUCTION AND INTERNAL ARRANGEMENT

The case itself is a wooden box, made of one-half inch clear white pine, measuring 33 x 18 x 9 inches. It consists of two parts, the body of the box (6 inches deep) and the lid (3 inches deep), which are hinged at one end with three two-inch iron hinges and held securely in place when closed by two three-inch barrel bolts and a small clasp with a hook fastener at the other end. All the joints are made with flat-head screws set flush with the surface. The 33 x 18 inch sides are reinforced with 3 x 16 inch strips set crosswise four and one-half inches from each end.

Heavy one-inch leather straps, screwed to the reinforcing strips on each side and buckled when the case is closed to form about 18-inch loops, serve as handles. The case is conveniently carried by two people with the 18-inch dimension upright (as a large suitcase) either by using the strap loops directly as handles or by thrusting a strong pole from a seine or heavy dip net through the two loops. The dimensions of the case are such that it will stand upright on the floor behind the front seat or in the baggage compartment of any automobile of recent model. When in use the case is placed in a slightly elevated position and the lid opened to an angle of about 135 degrees. Thus, the operator may squat or sit comfortably in front of the open case with all equipment within easy reach.

The inside of the case (figure 1) is fitted with sample bottles, solutions and other glassware. In the six-inch wide compartment on the left is a two-liter dark glass bottle containing *N*/40 sodium thiosulphate.¹ It is covered with black cloth and provided with a calcium chloride tube and a glass delivery tube with screw clamp shown resting in a horizontal position along the upper shelf. The small shelf above this holds three Barnes dropping bottles containing dilute starch paste, phenolphthalein (0.5 per cent alcoholic) and methyl orange (0.05 per cent aqueous), the indicators required. On the shelf to the right are bottles for three other solutions (manganese sulphate, 480 grams, hydrous, with four molecules

¹The concentrations of the solutions indicated are taken from American Public Health Association, 1936, Standard Methods of Water Analysis, Eighth Edition, New York.

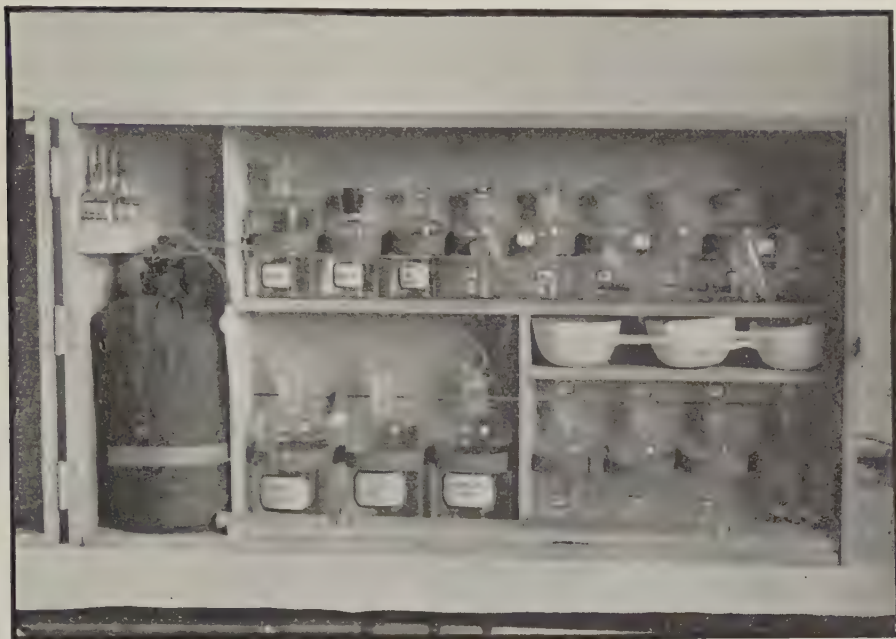


Fig. 1. Inside of the body of the case showing position of bottles and other equipment as described in the text.

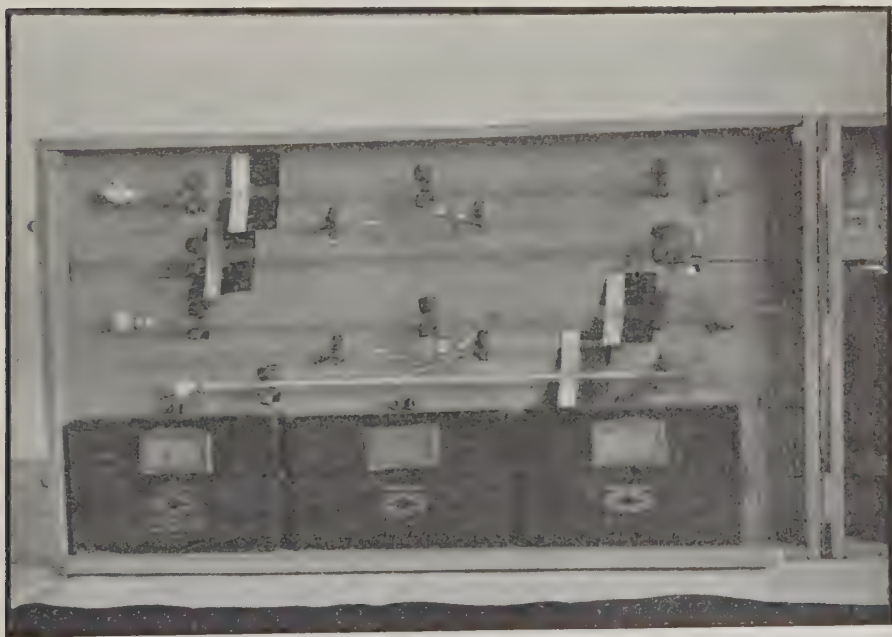


Fig. 2. Inside of the lid of the case showing position of burettes and other equipment when packed for closing the case.

of water per liter; sodium hydroxide, 500 grams, and potassium iodide, 150 grams per liter; concentrated sulphuric acid) required by the Winkler method (manganese chloride and hydrochloric acid are optional). Next, are six bottles of approximately 130 millimeters capacity labelled in pairs for duplicate water samples for oxygen determination.

Below are liter bottles of *N*/50 sulphuric acid and *N*/44 sodium hydroxide, for titration of carbonates and free carbon dioxide, and distilled water for rinsing pipettes and burettes. Next are four 250-milliliter bottles labelled in pairs for collecting water samples used in this analysis. All bottles are held in place with an ordinary web book strap laced through one inch staples properly spaced between the bottles. The labels are waterproofed with "Plicote" label glaze. In front of the lower tier of bottles are three wooden tubes holding one millimeter volumetric pipettes used for adding solutions in the Winkler method. Each tube and pipette is labelled according to the solution used to prevent contamination and mixing. Several stirring rods, towels, etc., may be carried here also. Inserted in holes bored diagonally through the shelf are three three-inch funnels suitable for pouring solutions into burettes and labelled according to the solution and burette with which each is used. Resting on the shelf below the funnels are three four-inch porcelain casseroles needed for titration of the water samples.

Inside the lid (Figure 2) are found four 50 milliliter, glass-stopcock burettes, one with a sidearm delivery tube, and two 100-milliliter volumetric pipettes which are held in place by metal finger-tip clamps covered with rubber tubing. Below is space for three La Motte block comparators of the standard six-cylinder style for colorimetric pH determination. The indicators carried can be varied according to local needs but thymol blue (9.6-8.0), phenol red (8.4-6.8) and chlor-phenol red (6.8-5.2) or brom-cresol purple (6.8-5.2) serve most requirements.

USE OF THE EQUIPMENT

When the case is to be made ready for use the block comparators are removed and the hinged strip in front of them is lowered, as shown in Figure 2, to form a shelf for the casseroles. After the burettes have been removed from the clamps the latter may be turned ninety degrees and are so placed that the burettes may be inserted in them in a vertical position. The top of the lid is hinged so that it may be lifted to permit the burettes to project above the top of the case when in position for use.

The sidearm burette, used for sodium thiosulphate, is placed in the clamps nearest the hinged end allowing the delivery tube of the solution bottle, placed on top of the box, to connect conveniently. A small calcium chloride tube is provided for the top of this burette. Two burettes are marked for use with sulphuric acid and sodium hydroxide respectively. The fourth burette is provided for titration with *N*/50 sulphuric acid to determine total acidity, when that is desired, or for titration with silver nitrate (2.725 per cent with 8 per cent potassium chromate as an indicator, Harvey, 1928) for determination of salinity in marine habitats. In that case the additional solution bottles may be placed to suit individual convenience or expediency. For example, if a wider shelf is used the funnels may be moved to the left and all the sample bottles placed in a double row to the right. Then five liter bottles may be placed in the bottom row and the casseroles stacked in the right hand end.

Two 100-millimeter pipettes are provided for measuring samples of water to be titrated so that two people may work simultaneously as is generally the case. Surface or sub-surface samples may be collected readily without bubbling with a rubber tube fitted with a double-acting aspirator bulb. This tube, not shown in Figure 1, is usually carried in the space above the two-liter bottle. The 250-milliliter sample bottles are used for the Seyler method because that size

permits the titration of 100 milliliters of water with acid and another 100 milliliters from the same bottle with alkali, or the separate titration of 100 milliliters with phenolphthalein and with methyl orange indicators if that is desired when no alkali titration is required.

The preparation and use of solutions, the collection and analysis of suitable water samples and the interpretation of the methods referred to in this description are extensively discussed by Allee and Oesting (1934), American Public Health Association (1936), Birge and Juday (1911), Ellms and Beneker (1901), Harvey (1928) and Seyler (1894). The use of the concentrations indicated and samples of appropriate volume reduces the calculation of results to such simple arithmetic that it can be carried out immediately in the field. For the convenience of students who may use these directions without having available the references mentioned the following calculations are indicated. The first four are taken from American Public Health Association, 1936; the last one and the corrections for salt error in pH are from Harvey, 1928.

For oxygen in parts per million (100 ml. sample).

$$2 \times \text{ml. of } N/40 \text{ sodium thiosulphate} \times F^n \times F^v$$

F^n is a normality factor; F^v is a correction for the loss of 2 ml. of water when solutions are added to the sample bottle. Using a 130 ml. bottle, $F^v = 130 \div (130 - 2) = 1.016$.

For carbon dioxide in p. p. m. (100 ml. sample).

$$10 \times \text{ml. of } N/44 \text{ sodium hydroxide.}$$

Free carbon dioxide $\times 2.272$ equals free carbon dioxide in terms of p. p. m. of calcium carbonate.

For phenolphthalein alkalinity in terms of p. p. m. of calcium carbonate (100 ml. sample).

$$10 \times \text{ml. of } N/50 \text{ sulphuric acid.}$$

For methyl orange alkalinity in terms of p. p. m. of calcium carbonate (100 ml. sample).

$$10 \times \text{ml. of } N/50 \text{ sulphuric acid.}$$

For salinity in parts per thousand (10 ml. sample).

$$\text{Salinity in p. p. t.} = \text{ml. of } 2.725 \text{ per cent silver nitrate.}$$

Corrections for salt error in pH of sea water.

Indicator	Salt Solution	pH Correction
0.04 per cent thymol blue (8.0-9.6).....	.5N NaCl	—0.17
0.02 per cent phenol red (6.8-8.4).....	" "	—0.15
0.04 per cent brom-cresol purple (5.2-6.8).....	" "	—0.25

The advantages of using a portable case of this kind vary, of course, with the circumstances. In the case of class work the main advantage has been the assignment of the factor analysis on a particular field trip to several students who carry out that phase of the work during the first hour in the field while others collect. Later, all join the leader in locating animals that have been missed previously and in observing the numbers, activities and adaptations of organisms collected. Rotation of this assignment permits all to practice the methods without unnecessary repetition. Another obvious advantage is the availability of additional samples when one is spoiled by the carelessness or clumsiness of beginners, making it possible to have complete data in the reports of every trip. Finally, upon returning to the laboratory, the factor analysis being complete, all can take part in storing

alive, preserving and examining all the specimens collected. This is especially important after an afternoon trip when time is limited.

To advanced students and working ecologists engaged in seasonal or other extended studies of the physical conditions of various habitats the advantages are those of convenience in transportation as well as speed, accuracy and completeness in obtaining results. In one instance, when a small panel truck was used for carrying camping, collecting and other field equipment, this case served as a convenient field laboratory keeping the glassware safe from jarring while in transit on rough roads and ready for use as soon as the rear of the truck was opened. Although experience with the case as described has been very satisfactory, no doubt suggestions for improvement can be made and will be welcome from any who care to submit them.

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Weary Plowman

A book certain to be much talked about is a small one on the subject of cultivation. The fly-leaf blurb hails it as the greatest advance of the century in scientific agriculture. Since its subject matter is not new, the exaggeration is obvious. The author does not make any such claim himself, fortunately, yet he boldly sets forth his inferences and conclusions from few or no experimental field data. He further attempts to bolster this stand by a cryptic remark about a certain noted botanist being the only scientist who could comprehend and properly appreciate his point of view. The subject matter, briefly, is concerned with using a disc harrow in place of a mold board plow. As a small book dealing seemingly with a topic of importance to food production it is most timely. But problems such as types of soil best managed by discing or plowing or costs of preparation or the results desired are somewhat lost in speculative discussions on water content of soils, mineral supplies in soils and other alleged benefits. As the crop from which the phenomenal yields are reported is the sweet potato, in which, as I understand it, the individual plants are set into place after they are four or more inches in length, any discussion of the amount of litter left on the soil after cultivation becomes somewhat academic. This book also states that the reason less organic matter accumulates as humus in forests than in prairies is because prairies are composed of annual plants. The author does not draw any further inferences from this remarkable statement.—A. E. Waller.

Plowman's Folly, by Edward H. Faulkner. 161 pp. University of Oklahoma Press, Norman, Oklahoma, 1943. \$2.00.

SOIL CONSERVATION DISTRICTS IN OHIO¹

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For many years I have heard the statement, "The Rainbow Comes Down in Ohio." Formerly, that statement, with all it implies, gave me a sort of warm glow of pride and satisfaction. More recently, however, has come the realization that rain, usually associated with the rainbow, results in erosion. On our ability to control erosion hinges our opportunity to continue to repeat this old saying with all its implications.

I feel it a real privilege to discuss with you a job that we are all coming to realize is so vital to the welfare of every citizen in Ohio regardless of his vocation. The hour is already late. The damage already done by erosion can be realized only partially. Translated into dollars and cents, the totals would stagger us, even accustomed as we are today to figures dealing in millions and billions of dollars. Furthermore, the losses continue to mount at an ever-increasing, accelerated rate. The solution, I firmly believe, will come through an enlightened, informed public. All the more reason, then, why I feel it is so appropriate, so timely to be discussing this with you educators here today.

I understand that others have discussed certain phases of this subject with you in past sessions. At the risk of repeating part of what may have been said, I would like to present very briefly and quickly the picture as we see it today.

Of the 26,318,000 acres in Ohio, approximately 22,000,000 acres are in farms; and about 10,000,000 of these acres are cropland—that is, subject to the plow. I do not need to tell this group that every type of topography is represented in this area, from the old lake plains in the northwest to the "Switzerland of Ohio" in Monroe County. We have approximately 190 types of soils—glaciated and residual, limestone soils and soils derived from sandstone and shale; heavy soils and light soils. Type of farming varies from intensive, as illustrated by vegetable growing, to the grazing and forest farming. Even the rainfall, while fairly uniform over the state, does vary in amount, time, and intensity. I mention all of these things because every one of them has a direct effect upon this problem of soil erosion and its control, which is the primary problem of soil conservation districts.

Most of us realize that Ohio is a relatively young state agriculturally. Five years ago, Marietta celebrated its 150th birthday. Most of the state has been farmed only about 100 years. However, few of us appreciate the toll that erosion has taken in that time. Actually, we do not have the exact picture because a complete, detailed survey has never been made of the whole state. Soils men have surveyed several scattered counties completely and a few years ago made a reconnaissance survey of the whole state. This type of survey is naturally subject to considerable error, but later surveys and information lead us to believe that our estimates are too conservative—that the problem is much worse than we first thought. Even so, these figures were bad enough because they show that one-sixth of the state, or approximately 4,500,000 acres, has lost 75 percent or more of the topsoil, while about one-third of the state, or approximately 8,000,000 acres, has lost from one-fourth to three-fourths of the topsoil. Therefore, over one-half of the total area of the state has a serious erosion problem. We are now convinced that most of the remainder of the state has lost considerably more soil than the survey indicated. Even the old lake plains in northwest Ohio, where most of us would think there was little erosion, are being affected, as is evidenced by the

¹Paper presented at the annual meeting of the Geography Section of the Ohio Academy of Science, April 30, 1943, Columbus, Ohio.

silted streams and clogged drainage ditches—most of the latter being less than 50 years old.

All of this has a very positive and direct bearing on this soil conservation district movement. Most of us may have been blissfully ignorant of what was going on before our very eyes and literally under our own feet. We saw fields going out of cultivation. Gullies scarred our fair hillsides. We did not appreciate then that gullies represent the last stages of erosion rather than the beginning. What were once fertile farms, producing good crops, fat cattle, and fine citizens, have slipped down the scale in all respects. We saw, but we saw “as through a glass darkly.”

Certainly we did not realize the full import of what was going on. These individual fields and farms began to take shape into patterns. They grew into communities, into counties, into areas. There are more of these eroded areas, and they are larger in size, than we like to admit. Some of you live in these areas. You know the situation and conditions. On the average, these areas have poorer buildings, poorer schools, poorer roads, poorer churches, and, yes, I'm afraid we'll have to admit—poorer citizens, in many cases.

Now please do not misunderstand me. I am not referring to any particular section of the state, but to those badly affected areas in all quarters of Ohio. And these conditions affect more than just the farmer making his living from the land. They have an immediate and direct effect upon the entire community—the banker, the dentist, the school teacher, the manufacturer, the auto mechanic, the motion picture man, the druggist, the insurance salesman. No single individual escapes.

Neither does the remainder of the state escape. Other sections must contribute part of their tax money for school aid in these areas. A disproportionate share of the gas tax helps maintain the roads. Old age pensions and unemployed relief take their toll also. Thus, the problem of the individual or the area becomes the problem of every citizen of Ohio regardless of who he is, where he lives, or what he does. Do not forget, too, this problem of erosion has a direct relationship to floods, to the ever-lowering water tables so important to industry and to the daily water supply of many of our cities.

As stated before, all that I have said has a direct bearing on the phenomenal growth and spread of the soil conservation district movement. I believe you will agree with me when I say it is phenomenal, when I tell you that in slightly over five years, there have been organized 841 soil conservation districts in the United States, including 490,000,000 acres of land in 42 of the 48 states.

Such a development did not “just happen.” There must have been many people concerned about the problem. All they needed was direction and leadership. Probably no one has done more to focus the attention, unify the thinking, and develop the action and leadership than Dr. H. H. Bennett, Chief of the Soil Conservation Service. As a soils man he traversed this country from north to south and from ocean to ocean, always looking, always digging and boring into the ground, always thinking, talking and preaching about what was taking place. For years he was “a voice crying in the wilderness.”

Finally he was heard. He was given his chance. Erosion experiment stations were set up in a number of different areas over the country. One is located at Zanesville. They told us in measured tons what was happening. They all told essentially the same story—and that story was startling indeed. Every thinking farmer and agricultural worker realized something had to be done. But what?—how?

The first answer was the demonstration project. Selected, representative areas were chosen where methods were tried out and techniques developed under actual farm conditions. They were successful to a degree but too slow in reaching the mass of farmers. Too often they were looked upon by the farmers as a “Government” project of little concern to them or their neighbors. Definitely they

were not the farmers' or the community's project. And all the while, the agricultural bank account in America—the soil—was dwindling at an alarming and an ever-accelerating rate.

What to do next was the problem. Obviously, the Government could not itself control erosion on the millions of farms in the United States. Some way, somehow, the man who is responsible for causing the erosion must be made conscious of the damage he is doing; if necessary, must be made to feel a responsibility and desire to do something about it, and finally must be shown what to do and how to do it and, in some cases, actually assisted in getting it done. That man is the individual farmer.

The soil conservation district idea seems to be the best answer to the erosion problem developed to date. At least it has caught the fancy of millions of farmers to the extent that they have incorporated themselves into legally-organized, locally-controlled units, with the main purpose of individually and cooperatively solving their own problems.

The State Legislature opens the way by passing the necessary enabling legislation. By petition, and through referendum, the district is created by the farmers themselves. By petition and election they nominate and select from their own group, the men to govern and guide the district's affairs. They, the farmers in the district, study and analyze their problems, develop their programs, make their plans, and apply the practices. The soil conservation district is really and truly agricultural democracy in action.

Now what is the soil conservation district situation in Ohio? In this movement Ohio must bow its head a bit because it was the 41st state to pass the enabling act. It was passed by the last Legislature in 1941, and became a law in September of that year. The Act provides for a State Soil Conservation Committee to assist districts with their organization and in many other ways. The committee is made up of the Dean of the College of Agriculture of the Ohio State University, the State Director of Agriculture, and three farmers appointed by the Governor. It began to function about February 1, 1942, and in April, 1942, the first referendum in Ohio was held in Highland County. To date eleven districts have been voted in, each covering an entire county and totaling 2,907,900 acres. They are located in the following counties: Highland, Butler, Clark, Morrow, Columbiana, Coshocton, Guernsey, Monroe, Noble, Tuscarawas, and Meigs. Logan County farmers held their hearing last week (April 22) and petitions are being circulated in Fairfield County now. Several other counties are in various stages of educational activities leading to district formation.

Now let no one be misled. The fact that these districts have been organized does not mean that their erosion or soil management problems are solved or will be in the next year or two. The ills of a century cannot be cured so quickly. In fact, erosion probably will never be stopped completely. It can be slowed up, however, to the point where good soil-building practices can keep pace with the erosion losses. There doubtless are farmers living within the districts who don't even realize that a district has been organized in their county or community. Some are even opposed to and voted against them. It is *your* job and my job, and the job of a host of other people, each working in his own way, to reach these people and help do this job that is so important, so vital to each of us.

Now perhaps you would like to know in a little more detail just how these districts function and what they are doing or planning to do. Please remember that in Ohio, the oldest district is less than a year old. Even so, some tangible plans have been developed and action is under way this spring.

To get a clearer picture of the actual operations of soil conservation districts, let us examine the programs and work plans of two of the older districts in Ohio and see just what the farmers themselves say are their problems and what they propose doing about them.

First, I'd like to quote what the supervisors of the Columbiana Soil Conservation District say is the purpose of their organization.

"The Columbiana Soil Conservation District was organized for a cooperative attack upon the problems of soil and water conservation, and to improve the farming practices whereby a satisfactory farm income can be received to maintain a desirable standard of living.

"The district intends to accomplish these results through cooperative efforts of local and county-wide farm and civic organizations, state and federal agencies, county and local government, neighborhood groups, and individual farm plans and demonstrations coordinated by the district supervisors."

After then giving a general description of their area, they point to one of their basic needs as follows:

"Wide variations in soil conditions exist throughout the district and on individual farms. A detailed soil map indicating soil types, grade of slope, extent of erosion, and possible land use, is essential in order to plan a sound soil building and soil and water conservation program."

They believe that adjustments in land use are fundamental to a sound agriculture as indicated in the following section.

"There is need for adjustment in the use of land so that each acre is put to its most suitable use.

"There is need for a plan for better use of large areas of land in the district.

"1. An area consisting of 67,634 acres or 21% of the county was designated non-agricultural land by the local land use planning committee. About one-half of this area is idle, one-fourth is cropland, and one-fourth is now in timber. Of this area, 30% was tax delinquent, 20% was operated by part-time farmers, and 31% of the families were on relief, in 1939.

"2. Coal strip mining operations are rapidly taking many acres of farm land. Many of these farms can no longer adequately support families from the farm income. Community and social problems result from reduced land valuation and reduced tax income. The effect of strip mining operations on the ground water table, and the most practical use to be made of the spoil banks need consideration."

I'd like to quote further from their program.

"EROSION:

"Over half of the land recommended by the Land Use Planning Committee for agricultural use in the county has a serious erosion problem. The remainder has a moderate erosion problem. Thousands of acres in the county have already been abandoned for farming because of erosion and thousands of acres are rapidly approaching abandonment. There is a need to develop and put into operation on most of the agricultural land of the county a program of land use and approved erosion control and water conservation practices.

"WATER:

"Because of the great amount of water required for crop production, farm water supply, and industrial purposes in this area, the constant lowering of the ground water table and the heavy run-off and frequent occurrence of floods, there is a growing need to increase the water intake of agricultural and non-agricultural lands of the county. Hence, water conservation practices need to be adopted on all lands in the district.

"FARM WOODLOT MANAGEMENT AND REFORESTATION:

"The county land use study indicated that 13% of the recommended agricultural area is now in farm woodlots of which 70% is now being pastured. It further indicated that 65% of the farm buildings are over 50 years old. A farm woodlot is needed on each farm to make the needed repair and replacement of farm buildings. . . . There is need for reforestation of many acres of idle and unproductive pasture and crop land.

"WILDLIFE:

"There is a need for protection of wildlife, and to improve ground cover and increase food for wildlife."

These extracts give you a good picture of what the supervisors and farmers in the district think are some of their most important problems demanding their attention. There are many more which we will not take the time to read. Let us see what they are doing to improve the situation.

Realizing the need of more information among the farmers in the district as being fundamental to the carrying out of their plans, their first proposal is as follows:

"EDUCATION:

"The district supervisors will foster an educational program designed to carry out the purposes and the programs of the district. The program will include meetings, newspaper publicity, demonstrations, tours, addresses, discussions, and other devices for informing farmers and the general public as to the problems outlined herein, and the solutions of those problems. . . ."

To obtain the necessary soils information, the supervisors have requested that:

"The Ohio Agricultural Experiment Station and the Soil Conservation Service, cooperating, make a soil survey of the entire district to be completed at the earliest practical date, and to make the soil maps and information available for immediate use in initiating and developing sound soil building and soil and water conservation practices. The supervisors will suggest the order of areas to be surveyed on the basis of interest and development within the district; and will use the maps to present land conditions, problems, and recommended programs to groups of farmers and to individual farmers."

To help with the technical planning:

"The district supervisors will request that the Soil Conservation Service furnish trained men to develop plans for soil and water conservation and to assist farmers in adopting these plans. They further request the services of the specialists of the Ohio Agricultural Extension Service in developing various phases of the district program and in carrying on educational work within the district."

The job of deciding what is needed on each farm, how to do it, and then fitting these plans into the farm operations, is the most difficult part of the whole program. With a soil survey map as the basis, the supervisors request and coordinate the assistance of just as many farmers, specialists, and agencies as possible, such as the Soil Conservation Service, the Extension Service, FSA supervisors, farm organizations, vocational agricultural teachers, AAA committeemen, county commissioners, township trustees, and others.

Most districts request the Soil Conservation Service to furnish assistance in helping develop conservation plans for farms and showing methods of application. The farmer himself applies the plan to his own land for the most part. Occasionally, when his problems tie in directly as part of a neighborhood problem, such as a large drainage ditch, his neighbors, the township trustees, highway department, and perhaps others, may all pool their efforts under the general guidance of the supervisors. I'd like to quote what they say about farm planning.

"It is intended that the principal part of the farm planning for erosion control and water conservation will be done by the group approach. An attempt will be made to get farmers with similar problems and conditions together and to develop with them plans for their farms.

"A farm plan will consist of as nearly a complete farm program for soil and water conservation as is possible. It will include adjustments to secure the best use of each acre, soil building practices, liming, rotations and cropping practices, conservation practices such as contour cultivation, contour strip cropping, sod waterways and water diversions, drainage systems, water supply systems, pasture management and improvement, woodlot management and reforestation, and a suggested balance between livestock and crops. It may also include farm power and labor adjustments and other factors of farm management which will increase farm income and improve family living."

We will not take the time to go into as much detail with the Clark County District. Somewhat the same general idea is indicated in their program, although expressed in a different manner and dealing, of course, with what they consider are their problems. They, like the Columbiana folks, feel the need of basic soil information and have requested a similar soil survey. I might add that both of these surveys are well along toward completion, the information being indicated on aerial photographs with individual pictures of his farm furnished to each cooperating farmer.

The Clark County District supervisors list three major objectives:

"(1) To conserve and build the soil. (2) To study and improve the water table. (3) To promote soil-saving agriculture that will maintain or better the farmers' standard of living."

They list eleven major problems; including erosion control, drainage, water supply, rotations, pasture improvement, reforestation and woodlot management, and farm tenancy.

These supervisors apparently believe in taking their own medicine because in the calendar they set up for farm planning they listed their own farms first. These, by the way, were planned last fall and are being put into operation this spring. They then listed the AAA Community Committeemen, followed by FSA clients. After these are planned, other planning groups will be arranged according to interest and requests as fast as they can be worked out.

In studying their district, they recognized four major areas: (1) Level to undulating, (2) undulating to gently rolling, (3) gently rolling to rolling, and (4) rolling to steep. With this classification as a basis, they then decided upon practice recommendations for the cropland, pastureland, and woodland. For example, on cropland in areas 3 and 4, which include their rolling lands, the recommend strip cropping on all slopes over 100 feet long. They think all natural drainageways should be kept in sod. For their woodlands they are recommending trees for all steep and eroded areas, protection from fire and livestock, improvement cuttings, and sound management.

I hope this partial review of the programs and work of these two districts may give you a clearer picture of what soil conservation districts are for and how they operate. You might say they are soil and water conservation cooperatives. Their goal is to secure the maximum production for each acre, indefinitely.

There is nothing particularly new or mysterious about soil conservation. It is just good common sense applied to the management of land. By nature, every acre is best adapted to a certain use. Our job is, first, to get each acre classified into its proper use; and, second, to get applied to each acre the necessary management practices.

Over 5,000 farmers in Ohio are already farming the "Conservation" way. They were cooperators with the old demonstration projects and CCC camps. They are trying these practices on their own farms and are finding them practical. What is particularly important right now is that they are finding that the application of some of these practices increases their crop production by 5, 10, or 25 percent, or more. Thus, contrary to the experiences of the last war, they can increase food production, which is so badly needed, and still have their farms in a good productive condition after the war is over.

Even with approximately one-ninth of the state already organized in soil conservation districts, the job is barely begun. To do all we believe must be done, every farm in these districts and in other districts to come, must apply those practices necessary to insure a permanent, prosperous agriculture. It's a big job—a tremendously important job. We need your help—*whoever* you are, or *wherever* you are. To get the job done will require "The everlastin' teamwork of every bloomin' soul." Then we can say again, with pride and assurance, "The Rainbow Comes Down in Ohio."

BUCKEYE LAKE WHITE BASS

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White bass (*Lepibema chrysops*) made up more than fifteen percent of all fish caught by trap nets over a twelve month period (1939-1940) from Buckeye Lake. Calculations based on catch records from these nets indicate that there were over eighty-eight tons of these fish, beyond their first summer, in the Lake. Since this species made up less than one percent of the catch of anglers (sports or recreation fisherman) it seems wise, at this time of national emergency, to examine its growth, in Buckeye Lake, with reference to use as a supplemental meat food.

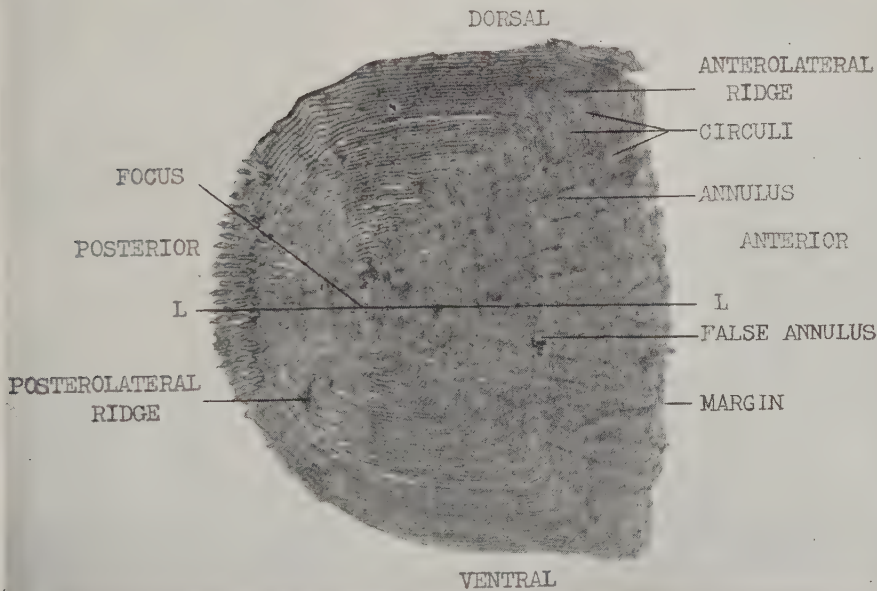


FIG. 1. White bass scale showing the main features, including a true annulus and a false annulus. This scale was taken from a seven-inch fish (total length) on June 17, 1939.

YEAR CLASSES

In as much as each fish caught by the nets was measured, curves of the length of predominating groups were prepared. These curves were very illuminating. They exhibited three nodes indicating three year classes of fish of a size that could be retained by our nets. Samples of smaller fish were very difficult to obtain by seining because they apparently roam through open water and do not inhabit shallow shores as do most of our other game species. The rapid movement of the

two larger nodes (year classes) to the right during the summer, however, indicated that this species had a fast growth and that there was probably but one year class that was not captured by our nets and that group consisted of the hatch of the year. From September, 1939, on, part of this group was caught by our nets.

Analyses of several hundred scales (taken from the fish as they were caught and measured), considering the annulus formation as indicating one completed year's growth, confirmed the assumption made from length frequencies (Figure 1). Thus Buckeye Lake white bass are primarily a three-year fish with a few hardy individuals living into their fourth summer (or occasionally longer).

Evidence shows that there is a decrease in numbers each successive year, possibly due to the hazards of life such as predators but apparently many of the fish die of old age. Boat livery men, particularly Mr. Bob Donaldson, relate

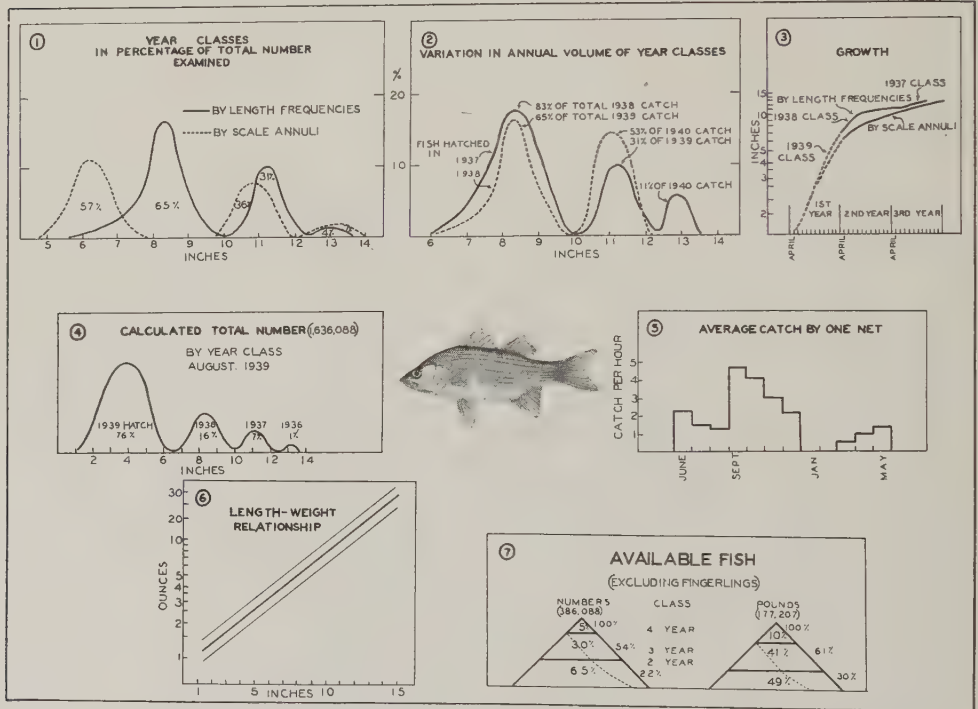


FIG. 2. Growth curves of individuals and distribution of the total white bass population in Buckeye Lake. Details of graphs are referred to in the text.

that weak and dead white bass are seen in the early spring drifting in the waters of the east end of the Lake where they are not normally found, and of course, many of those that die sink to the bottom or are eaten by turtles and other scavengers and are therefore not seen in numbers. We have, then, a species of fish that appears to reach a physiological limit in its life cycle at around its fourth year.

This is an unusual situation in that most species of wildlife are not believed to complete their life span through physiological deterioration, because of the violence of the natural hazards surrounding their every day activities.

This was reported before the American Fisheries Society at Toronto in September, 1940, and briefly mentioned in the Ohio Journal of Science later (Roach, 1942). These data appear with Figure 2 as Graph 1.

VARIATION IN VOLUME OF YEAR CLASSES

The numbers of white bass in a certain year class may vary somewhat from year to year depending on several factors, particularly success of spawning, availability of food, population pressure, climatic conditions and the size and numbers of other predaceous fish.

Graph 2 portrays this point and shows that fish hatched in 1937 made up 83 percent of the total catch in 1938 (second year class), 31 percent in 1939 (third year class), and 11 percent in 1940 (fourth year class); whereas fish hatched in 1938 made up only 63 percent of the second year class (1939), but 53 percent of the third year class (1940).

GROWTH

Graph 3 was prepared to show the growth of white bass as calculated from measurements between annuli on the scales and as determined by the length measurements made in the field in 1939 and 1940. The close correlation is striking. One would naturally assume some variations due to yearly food, climatic and population differences, particularly in the smaller fish. This graph indicates that, on an average, white bass reach a length of nearly six inches their first year, nearly ten inches their second year and approach twelve to fourteen inches their third year. The near absence of fish beyond fourteen inches is worth mentioning.

TOTAL NUMBER

The total number of white bass in Buckeye Lake was calculated from catch and recatch records using the formulae developed by Illinois and Wisconsin fisheries biologists and reported by Schnabel in 1938.¹

From these calculations there appeared to be 1,636,088 white bass in Buckeye Lake in late July or early August, 1939. Graph 4 shows these in their respective year groups (as calculated in percentages of the second, third and fourth year classes after determining the normal curve of the second year class).

Examination of these data indicates that with 100 young of the year there were 21 yearlings, nine two-year-olds and one three-year-old.

MOVEMENTS

Fisherman catch many white bass from Buckeye Lake in the early spring when they are apparently spawning or feeding on gizzard shad (*Dorosoma cepedianum*) spawn along the steep sided north bank.

Catch records of our net (set at considerable distance from the north bank) indicate that we missed the major spring movement. However, for the Lake as a whole (Graph 5) the movement of white bass decreased as summer progressed, increased tremendously in the autumn and gradually decreased with the approach of winter. No white bass were taken under the ice sheet which covered the Lake in January and February, 1940.

AVAILABLE FISH

Graph 7 has been prepared to show the number of white bass present above the fingerling (first summer) stage. With this is another showing the weight of white

$$N = \frac{\sum M_i D_i}{R} \quad \text{or} \quad \frac{\sum M_i T_i}{R}$$

where M_i = the total number of fish tagged in the lake when fishing i th time
 D_i = New fishes caught untagged i th time
 r_i = recatches i th time
 T_i = $D_i + r_i$ = total caught i th time
 R = $\sum r_i$.

bass in each year class (this latter pyramid was prepared by using length weight conversion tables from which graph 6 was constructed). The data are from the same source as Graph 4.

Examination of these pyramids indicates that more than 386,000 white bass weighing 177,000 pounds (nearly 89 tons), all of yearling age or over, were present in Buckeye Lake in late July, 1939.

If trap nets of the same mesh size as our test nets were used to harvest white bass, catch control insuring an adequate surviving brood stock would be comparatively simple. For example, if all the fourth summer fish were removed by these nets and the other year classes were caught in proportion to their numbers in the Lake, 54 percent of the third summer fish and 22 percent of the second summer fish would be taken. This would average a removal of 40 percent of all adult fish from the Lake (53 percent by weight), leaving around 231,000 breeders in the water. This brood stock plus young of the year should be more than adequate to repopulate the Lake by the following fishing season. (Thompson and Bennett, 1938).

If evidence arises to the effect that an overtake occurs and depopulation is imminent, reduction or curtailment of take could be easily made. In any event 46 tons of white bass or any portion thereof should be a worthwhile addition to the central Ohio meat supply.

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Milk Sickness

Dr. Moseley, in his book "Milk Sickness Caused by White Snakeroot," has presented material which he has collected on the subject for a period of over forty years, including his discovery of the causative agent, White Snakeroot. History of the scourge of milk sickness in pioneer days, experimental evidence as to the causative agent, symptoms of the illness in farm animals, laboratory animals and man, medical treatment and description, illustrations and distribution of White Snakeroot, are subjects which make up most of the volume. The book will be of value and interest to medical men, veterinarians, agriculturists, historians, and botanists.—G. W. B.

Milk Sickness Caused by White Snakeroot, by Edwin Lincoln Moseley. 171 pp. Lithographed. Published jointly by The Ohio Academy of Science and the author. 1941. \$1.00. A copy will be sent to any member of The Ohio Academy of Science without cost. To obtain a copy, write to Mrs. Ethel M. Miller, Librarian, Botany and Zoology Bldg., The Ohio State University, Columbus, Ohio.

World Trade in Agricultural Products

It is remarkable to have compressed within a single volume so much information on a large and important subject. The review of agricultural export and import during the years between World Wars I and II gives us a picture of our present situation and possible guidance for the future. Agricultural trade not only shows us the peaceful ways of balancing illogical distribution, but points to backgrounds of conflict. This volume has a high measure of reliability since the basic data are from the International Institute of Agriculture at Rome and our own United States Department of Agriculture. It is an indispensable handy reference for any one interested in a world view of agriculture. Topics covered in the chapters include cotton, wool, silk, rubber, tobacco, coffee, tea, sugar, wheat, rice, meats, fats and oils.—A. E. Waller.

World Trade in Agricultural Products, by Henry C. Taylor and Anne Dewees Taylor. 286 pp., 23 charts, 18 maps, 59 statistical tables. The Macmillan Co., New York, 1943. \$3.50.

RECORDS OF OHIO DRAGONFLIES

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During the past few years a large number of Ohio records of dragonflies have been accumulated from collections received for determination and from personal collecting within the state. These include numerous new county records and one species new to the Ohio list. All of the specimens were identified by the author except one specimen each of *Epiaeschna heros* and *Perithemis tenera* and a series of 40 specimens of *Anax junius*, the records of which were furnished by Homer F. Price.

All of the records from Defiance, Mercer, Paulding, Putnam and Williams counties are based upon collections made by Homer F. Price of Payne, Ohio. The greater part of these collections were made in Paulding County throughout the 1942 season, although a few were obtained in the latter part of the summer of 1941. Localities listed for Paulding County include Flatrock, Marie DeLarme and Blue Creeks, the Auglaize River at Fort Brown, the Maumee River in Crane Township and gravel pits in Benton and Paulding Townships. Mr. Price's collections from the other counties were made during 1942, as follows: Defiance—Auglaize River near power dam, May 24, June 15, July 7, 27 and 31; Auglaize River near Defiance, July 27; Maumee River near Independence Dam, July 7; Mercer—Grand Lake, July 4; Grand Reservoir, July 22; St. Mary's River, July 4 and 7; Putnam—Auglaize River east of Cloverdale, June 28; Williams—Nettle Lake and St. Joseph River, June 22. As all of these collections represent new county records they are given, with such notes and comments as seem of interest, in the list below.

One of the specimens collected by Mr. Price belongs to a species (*Somatochlora linearis* Hagen) not previously reported from Ohio. This species has a range covering the eastern half of the country; there are records for most of the states from Quebec and Maine to Georgia, and for Missouri, Illinois and Indiana. In Indiana it has been found to be rather abundant locally, mostly along woodland streams, or in neighboring open glades and roadways through the forests (Montgomery, 1934, 1941). The most recent paper on Ohio Odonata (Borror and Epstein, 1942) gives the number of species known from the state as 132, and the present addition brings this number to 133.

Records from Erie, Marion and Ottawa counties were compiled from collections made by Robert P. Mullett. The Erie County collections were made in the vicinity of Sandusky from April to July, those from Marion at Durfee's Lake, Marion, June 9, and the Whitstone River at King's Mill, July 15, and that from Ottawa on South Bass Island, August 6—all during 1942. The South Bass Island collection included specimens of *Neotetrum pulchellum*, *Pachydiplax longipennis*, *Argia apicalis*, *A. moesta*, *Enallagma carunculatum*, *E. ebrium*, *E. exsulans*, *E. hageni*, and *Ischnura verticalis*. This date, August 6, extends the known seasonal range in Ohio of *E. ebrium* and *E. hageni*, the latest previous records being July 15 and July 10, respectively. On April 30, at the Sandusky city dump, Mr. Mullett found females of *Ischnura verticalis* ovipositing and "observed one female laying eggs in a cattail stem under water for three minutes and ten seconds." *Anax junius* was taken here on the same date and later in the season 14 other species—*Gomphus spicatus*, *Perithemis tenera*, *Holotania luctuosa*, *Plathemis lydia*, *N. pulchellum*, *Sympetrum obtusum*, *S. rubicundulum*, *P. longipennis*, *Erythemis simplicicollis*, *Tramea lacerata*, *Lestes disjunctus*, *A. apicalis*, *Enallagma anten-*

natum and *E. exsulans*—were taken at the same habitat and/or in an adjacent quarry.

The Portage County records were obtained from a small collection made near Garrettsville in 1936 by William Thrasher and sent in exchange for specimens of Coleoptera.

The Darke County specimens were collected along Greenville Creek, two to five miles southeast of Union City, June 26, 1942, by E. Phillips Blackburn and the author.

The Butler County records are the results of two visits to the campus of Western College at Oxford to obtain specimens of *Archilestes grandis* Rambur. A collecting party consisting of Lynn Robertson, Jr., Marshall B. McDonald and the author, made a brief stop August 24, 1939, en route home from a collecting trip to the Southeast (Montgomery, 1940), and the author, accompanied by his wife and daughter, spent a short time here October 6, 1940. The creek on the Western College campus has been described by Williamson (1930) in his account of the capture of *grandis* here, September 25 and October 11, 1927—the first record of this species northeast of Oklahoma. In 1939 we found this creek very low, only a trickle of water through the culvert in the dam below the pool and only scant cupfuls here and there among the broken pieces of limestone in the creek bed below the dam. In 1940 there was even less water and the pool above the dam was reduced in size with some mud flats exposed around its margin. No individuals of *A. grandis* were seen around or above the pool where Williamson found them comparatively abundant in 1927, but a few males—one in 1939, two in 1940—were seen and captured in the creek bed below the dam. In 1939 we found several other species of dragonflies around the pool—swarms of *Erythemis simplicicollis* and *Ischnura verticalis*, considerable numbers of *Pachydiplax longipennis* and *Enallagma civile*, and occasional individuals of *Plathemis lydia*, *Holotania luctuosa*, *Tramea lacerata* (teneral), *Lestes rectangularis* and *Ischnura posita*. In 1940 the season was quite late at the time of our visit and dragonflies, except *Sympetrum*, were rather rare. The specimens of *Sympetrum* captured included *obtrusum*—3 ♂, *rubicundulum*—1 ♂, and *vicinum*—11 ♂, 5 ♀. The other specimens taken were *Aeshna umbrosa*—1 ♀, *Lestes congener*—5 ♂, *Enallagma civile*—1 ♂, and *Ischnura verticalis*—1 ♂, 3 ♀. The presence of *A. grandis* in the same habitat after an interval of 13 years indicates that it has established itself more or less permanently in this region.

Only a few representative and especially interesting specimens from the collections determined for Homer F. Price and Robert P. Mullett were retained for the collection of the author, the remainder were returned to the collectors. The 1939 specimens from Butler County were sent to the Museum of Zoology at the University of Michigan. All other specimens are in the collection of the author.

In the following list the species are numbered according to Borror's 1937 and 1938 lists and the records are given by counties. However, interesting observations, dates extending the known seasonal range for Ohio (these dates are starred*), and further information on specimens of rare or unusual species are included and additional collection data are given for records of specimens not included in the collections described above.

4. *Ophiogomphus rupinsulensis* (Walsh). Ashtabula—1 ♂, Geneva, *August 4, 1940, A. L. Burhanna.

8. *Gomphus crassus* Hagen. Defiance—Auglaize River, June 15 and *July 7.

10. *Gomphus fraternus* (Say). Putnam.

12. *Gomphus graslinellus* Walsh. Defiance—Auglaize River, June 15, July 7; Paulding—Flatrock Creek, June 5, July 2, 14, and *27.

25. *Dromogomphus spoliatus* (Hagen). Defiance, Paulding—Auglaize River at power dam and near Fort Brown, *June 21 to *July 31.

31. *Anax junius* (Drury). Mercer, Paulding. Mr. Price sent records of about 40 specimens of this species taken in Paulding County from September 5 to October 8, 1942, with a note that "several attempts were made after October 8 to take specimens, but none were seen."

34. *Epiaeschna heros* (Fabricius). Paulding—1 ♀, May 6, 1942, "found nearly dead on screen on cold morning by Dorothy Wood."

36. *Aeshna constricta* Say. Paulding.

38. *Aeshna umbrosa* Walker. Portage.

42. *Cordulegaster obliquus* (Say). Portage—1 ♂, May 29, 1936.

45. *Macromia taeniolata* Rambur. Defiance—1 ♂, July 27, and 3 ♂, July 31, Auglaize River near power dam. Two of these specimens vary somewhat from the characteristics listed for this species by Williamson (1909) towards those of *wabashensis*—keel of second tibia approximately one-third of length of tibia (keel 3.5 mm., length of tibia 11 mm.), a single dorsal yellow spot on segment 8, and lateral yellow spots on frons. Also a female taken along the Auglaize River at Fort Brown, Paulding County, June 21, 1942, does not belong to this species, but as the specimen is somewhat teneral its specific position is difficult to determine. These specimens, along with a considerable number from other sources, are being held for further study as there is much need for a thorough revision of the North American species of *Macromia*.

*133. *Somatochlora linearis* (Hagen). Paulding—1 ♂, Flatrock Creek, August 3, 1941. This is an addition to the Ohio list.

54. *Perithemis tenera* (Say). Mercer, Paulding.

64. *Holotania luctuosa* (Burmeister). Paulding, Williams.

65. *Plathemis lydia* (Drury). Defiance, Paulding, Williams.

66. *Neotetrum pulchellum* (Drury). Defiance, Williams.

68. *Eolibellula semifasciata* (Burmeister). Paulding.

70. *Sympetrum ambiguum* (Rambur). Paulding—1 ♂, along open ditch at edge of woodlot, *October 4. "Three heavy frosts before this date." *Sympetrum vicinum* and *Lestes disjunctus* were also taken on this date.

72. *Sympetrum obtusum* (Hagen). Butler, Williams.

73. *Sympetrum rubicundulum* (Say). Defiance, Mercer, Paulding, Williams. *May 5 to *October 6.

76. *Sympetrum vicinum* (Hagen). Paulding.

77. *Leucorrhinia intacta* (Hagen). Marion.

78. *Pachydiplax longipennis* (Burmeister). Defiance, Marion, Mercer, Paulding.

79. *Erythemis simplicicollis* (Say). Butler, Williams.

81. *Pantala hymenaea* (Say). Paulding—1 ♀, *September 19.

82. *Tamea carolina* (Linnaeus). Marion, Paulding. June 9, *September 14. Mr. Price noted on September 14, that "the Tameas were rather common around the yard and orchard today. There was a stiff breeze and the Tameas hunted in the lee of the trees and rested well up on the higher branches where I could not get at them."

83. *Tamea lacerata* Hagen. Paulding.

87. *Calopteryx maculatum* (Beauvois). Darke, Paulding, Williams.

88. *Hetaerina americana* (Fabricius). Darke, Putnam.

91. *Lestes congener* Hagen. Butler.

92. *Lestes disjunctus* Selys. Defiance, Marion, Mercer, Paulding. May 12 to *October 4.

96. *Lestes rectangularis* Say. Mercer, Paulding, Williams.

97. *Lestes dryas* Kirby. (Listed by Borror as *L. uncatatus* Kirby, but Cowley, 1935, has shown that this name is a synonym.) Mercer, Paulding. *June 5 to July 14.

98. *Lestes unguiculatus* Hagen. Paulding.

100. *Argia apicalis* (Say). Defiance, Marion, Mercer, Paulding, Putnam.

102. *Argia moesta* (Hagen). Defiance, Marion.

104. *Argia tibialis* (Rambur). Darke, Marion, Mercer, Williams.

105. *Argia violacea* (Hagen). Darke, Paulding, Williams.

106. *Amphiagrion saucium* (Burmeister). Williams.

110. *Enallagma antennatum* (Say). Paulding.

128. *Enallagma basidens* Calvert. Paulding. June 15 to August 2.
 113. *Enallagma carunculatum* Morse. Darke.
 114. *Enallagma civile* (Hagen). Defiance, Paulding.
 118. *Enallagma exulans* (Hagen). Darke, Defiance, Marion, Paulding. *May 14 to August 7.
 121. *Enallagma signatum* (Hagen). Darke, Paulding, Williams.
 124. *Ischnura posita* (Hagen). Marion, Paulding.
 126. *Ischnura verticalis* (Say). Defiance, Marion, Paulding.
 127. *Anomalagrion hastatum* (Say). Darke.

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Aerial Photographs

New views of our old world can bring new thoughts and, perhaps, help teach man a little more about how to live decently. Aviation gives man a new environment and a better chance to interpret familiar scenes. Mapping from aerial photographs has been shown to have practical advantages over surface surveys for certain purposes. The list of occupations in which aerial photography is becoming a useful tool is growing rapidly. Of equal importance is a knowledge of how the photographs have been made and how they are to be interpreted. Dr. Smith's book rounds out, in a satisfactory way for beginners, the many things we can learn from good photographs.—A. E. Waller.

Aerial Photographs and Their Applications, by H. T. U. Smith. 312 pp., many photographs. D. Appleton Century Co., New York, 1943. \$3.75.

Fogs, Clouds and Aviation

The ninety-three full-page photographs of cloud forms and cloud phenomena in this little book leave only one hundred-six pages of text, index and references. But these pages are delightfully written in clear and as nearly non-technical English as is practically possible. For those possessing but an elementary knowledge of physics, the explanations of the various cloud formations help in understanding and appreciating these commonly disregarded and unappreciated natural phenomena. For the amateur meteorologist these explanations are aids in making short range weather predictions. For the aviator both in peace and wartime there are suggestions for making use of the existing clouds. He is also shown which ones to avoid. This book cannot fail to interest all those for whom the weather is more than something to grumble or exclaim about.—Richard T. Wareham.

Fogs, Clouds and Aviation, by W. V. Humphreys. I-XII+200 pp.; 94 full-page illustrations. The Williams and Wilkins Co., Baltimore, 1943. \$3.00.

Behind the Sulfa Drugs

The readers of Dr. Galdston's essay will be interested in tracing the changes in thinking about diseases as bacteriology has advanced. Claude Bernard's dictum "That which we know frequently impedes us in acquiring new knowledge" is apropos. While we may kill bacteria outside the human body with substances like corrosive sublimate, or iodine, we are handicapped trying to use the same methods to kill if the organisms are inside living cells. Bacteriology and Chemotherapy overlap somewhat. Chemotherapy now augmented by the sulfa drugs and with penicillin may be said to be getting started. Readers will find that the background includes more than the decade of research that brought forth the sulfa drugs.—A. E. Waller.

Behind the Sulfa Drugs, by Iago Galdston, M. D. 174 pp. Appleton Century, New York, 1943.

PROTOZOAN PARASITES OF THE ORTHOPTERA, WITH SPECIAL REFERENCE TO THOSE OF OHIO

IV.¹ CLASSIFIED LIST OF THE PROTOZOAN PARASITES OF THE ORTHOPTERA OF THE WORLD.—(*Continued*)

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Class 4. CILIATA Perty, 1852.

Possess cilia or cirri during the trophic stage.

Order 1. HOLOTRICHIDA Delage and Hérourard, 1896.

Cilia uniformly distributed over the entire body surface. Adoral zone never present.

Family 1. *Isotrichidae* Bütschli, 1889.

Body covered by a thick pellicle. Ciliation uniform and thick. (Majority found in the mid-intestine of ruminants.)

Genus 1. *Isotricha* Stein, 1858. Body ovoid. Cytostome at anterior end or somewhat to one side.

Isotricha caulleryi Weill, 1929.

References: (1) Weill, 1929, 24.

Synonymy: Name unchanged.

Hosts: (a) *Periplaneta americana* (Linnaeus), (1).

Habitat: Alimentary canal, (1a).

Distribution: French Indo-China, (1a).

Order 2. HETEROTRICHIDA Delage and Hérourard, 1896.

Body usually covered by delicate cilia. Adoral zone, which is wound to the right (clockwise), composed of strong cilia or membranellae.

Family 1. *Plagiotomidae* Claparède and Lachmann, 1858.

Adoral zone parallel to main body axis; peristome narrow and long.

Genus 1. *Nyctotherus* Leidy, 1849. Body oval or reniform. Peristome begins a little back of anterior end of body and forms cytostome.

Nyctotherus ovalis Leidy, 1850.

References: (1) Siebold, 1839, 69; (2) Leidy, 1850, 100; (3) Leidy, 1853b, 244; (4) Leidy, 1853c, 41; (5) Stein, 1854, 42; (6) Leidy, 1856, 43; (7) Stein, 1856, 36; (8) Claparède and Lachmann, 1858, 240; (9) Stein, 1859, 78, 84, 85, 90; (10) Stein, 1860, 50; (11) Stein, 1862; (12) Stein, 1867, 344; (13) Leidy, 1879, 204; (14) Grassi, 1881, 197; (15) Schuster, 1898, 244; (16) Belar, 1916, 242; (17) Zulueta, 1916, 5; (18) Kudo, 1922, 113; (19) Yakimoff and Miller, 1922a, 9; (20) Yakimoff and Miller, 1922b, 133; (21) Pinto, 1926, 14; (22) Tejera, 1926, 1382; (23) Bhatia and Gulati, 1927, 86, 113, 116; (24) Lucas, 1927b, 224, 232; (25) Lucas, 1928, 161; (26) Weill, 1929, 22; (27) McAdow, 1931, 16; (28) Balch, 1932, 237; (29) this paper, parts II and III.

Synonymy: "*Leucophrys-artiges* Infusorium," (1); *Nyctotherus ovalis*, (2), (3), (4), (6), (11), (12), (13), (14), (15), (16), (17), (18), (19), (20), (21), (22), (23), (24), (25), (26), (27), (28), (29); *Bursaria blattarum* (5), (7), (9); *Plagiotoma Blattarum*, (8), (10); *Plagiotoma blattarum* (9).

Hosts: (a) *Blattella germanica* (Linnaeus), (5), (23), (27); (b) *Parcoblatta pennsylvanica* (DeGeer), (29, *N. ovalis* variety?); (c) *Blatta orientalis* Linnaeus, (1), (2), (3), (4), (5), (17), (23), (24), (27); (d) *Periplaneta americana* (Linnaeus), (15), (21), (23), (25), (26), (27); (e) *Gryllotalpa gryllotalpa* Linnaeus, (23); (f) Undetermined species of wood-cockroaches, (21).

¹Part I: Ohio Jour. Sci., 36: 315-320. 1936. Part II: Ohio Jour. Sci., 39: 157-181. 1939. Part III: Ohio Jour. Sci., 41: 457-464, 1941. Part IV: Ohio Jour. Sci., 43: 221-234. 1943, and continued in this issue.

Habitat: Alimentary canal, (1c), (2c), (3c), (5a), (5c), (17c), (21d), (21f), (23a), (23b), (23d); mid-intestine, (23d); hind-intestine, (23d), (24c), (26d), (29b); colon, (15d), (27a), (27c), (27d); rectum, (27a), (27c), (27d).

Distribution: Brazil, (21d), (21f); London, England, (24c); French Indo-China, (26d); Berlin, Germany, (17c); Lahore, India, (23d); United States, (2c); Urbana, Illinois, (18c); Ohio, (27a), (27c), (27d); Champaign County, Ohio, (29b).

Family 2. *Bursariidae* Stein, 1867.

Adoral zone parallel to main body axis. Peristome wide, triangular and deep.

Genus 1. *Balantidium* Claparède and Lachmann, 1858. Body large, oval to subcylindric, slightly truncate anteriorly. Peristome medium wide and slightly oblique in direction.

Balantidium ovatum Ghosh, 1922.

References: (1) Ghosh, 1922b, 371; (2) Bhatia and Gulati, 1927, 85; (3) Weill, 1929, 22; (4) McAdow, 1931, 21.

Synonymy: Name unchanged.

Hosts: (a) *Periplaneta americana* (Linnaeus), (1), (3).

Habitat: Alimentary canal, (1a); rectum, (3a).

Distribution: French Indo-China, (3a); Calcutta, India, (1a).

Balantidium blattarum Ghosh, 1922.

References: (1) Ghosh, 1922a, 15; (2) Bhatia and Gulati, 1927, 85; (3) McAdow, 1931, 21.

Synonymy: Name unchanged.

Hosts: (a) *Periplaneta americana* (Linnaeus), (1).

Habitat: Alimentary canal, (1a).

Distribution: Calcutta, India, (1a).

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Tropical Paradise Lost

This is the story of an expedition to collect seeds from the Philippines and Netherlands India. Dr. and Mrs. David Fairchild were guests of Mrs. Anne Archbold on her Chinese junk "Cheng Ho." From January to July in 1940 they sailed among the islands of the Celebes Sea, the Bauda Sea and the Bali Sea. They traveled as far as Manila in the North to Amboina in the Southeast and Soerabaja in the Southwest. Some ports led them to old friends and one wonders, on reading this two years after Pearl Harbor, what may have become of them. The "finds" were safely returned in spite of war-time problems. As was brought out in the two previous books of Dr. Fairchild, the book is not the real end product. There are many interesting plantings growing up in many places from the materials introduced. The 125 photographs would alone make this book an excellent record of tropical plants. It is not given to many men to produce a post-autobiography; fewer still take a recall bow so gracefully.—A. E. Waller.

Garden Islands of the Great East, by David Fairchild. 239 pp., 125 photographs and map inside jacket. Charles Scribner's Sons, New York. 1943. \$3.75.

Animal Breeding Plans

The second edition of that excellent text on animal breeding differs from the first edition principally in two chapters. The chapter "How Selection Changes a Population" has been expanded into two chapters, "How Selection Changes the Genetic Composition of a Population" and "How Selection Changes a Population—The Outward Results." The chapter on "The Family System" has been expanded and entitled "Family Structure of Populations." These changes are notable improvements in that the material is brought up to date and is also presented in a simpler manner.

This text is designed for the professional student of animal breeding, who has had courses in genetics, physiology and animal husbandry. The author has done a highly commendable job of presenting the applications of sound genetic principles to the many problems confronting the practical animal breeder. Professional animal breeders, as well as students of advanced animal husbandry, can ill afford to overlook *Animal Breeding Plans*.—D. C. Rife.

Animal Breeding Plans, Second Edition, by Jay L. Lush. The Iowa State Collegiate Press, Ames, Iowa. 1943. \$3.50.

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